A STREET & SMITH PUBLICATION

ASTOUNDING

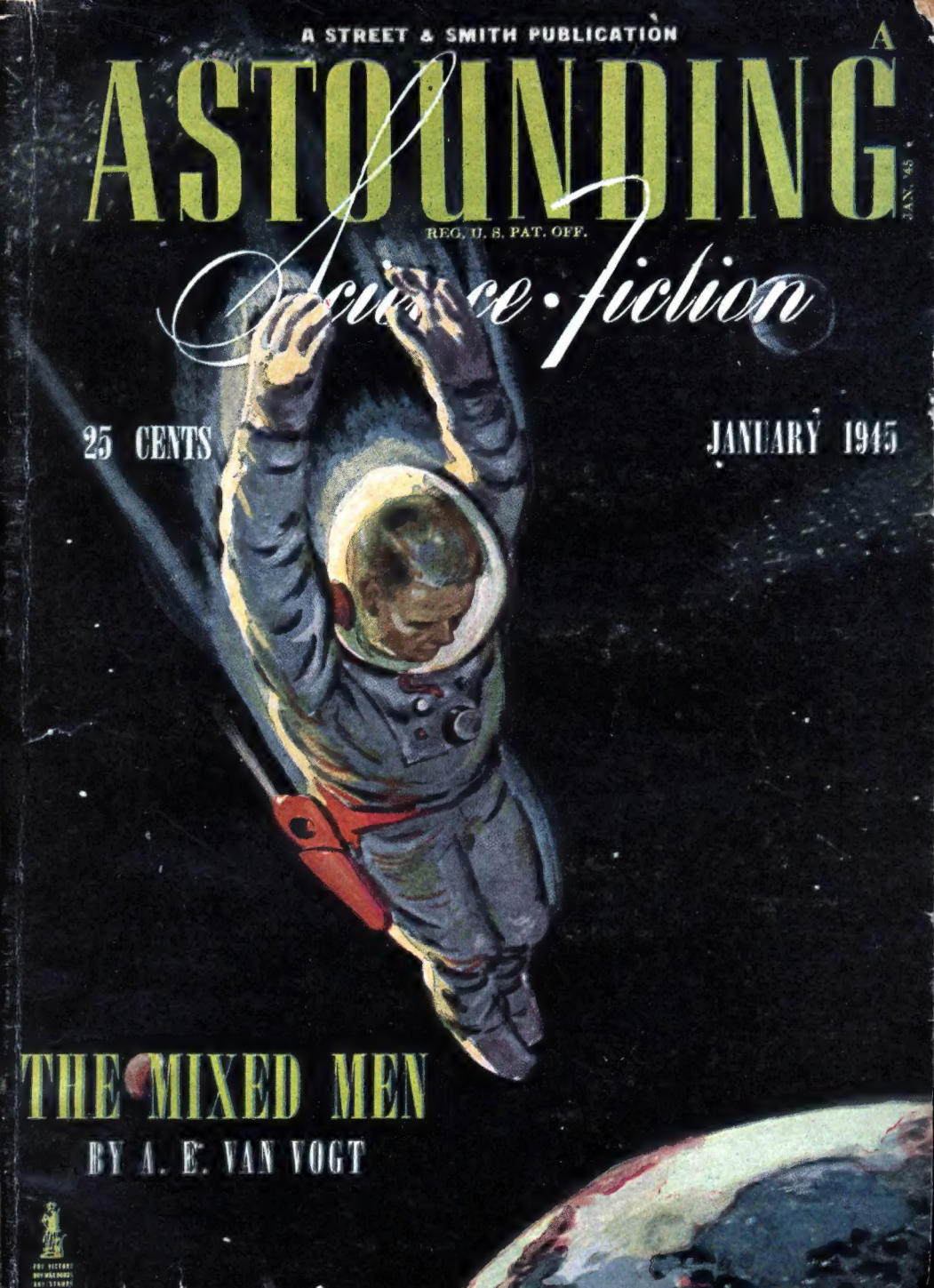
REG. U. S. PAT. OFF.

Science-fiction

JAN. '45

25 CENTS

JANUARY 1945



THE MIXED MEN

BY A. E. VAN VOGT

Colds? Sore Throat?

Let LISTERINE ANTISEPTIC *get after the germs that go with them!*

The delightful Listerine Antiseptic gargle taken early and often may spare you a nasty siege of trouble. Here is why:

Listerine Antiseptic reaches way back on throat surfaces to kill millions of germs called the "secondary invaders," some of which are shown to the right. These are the very types of germs that so many specialists say are to blame for the troublesome aspects of a cold.

Listerine Antiseptic's quick, germ-killing action helps to guard against a "mass invasion" of such germs into the tissues where they may set up or aggravate the infection you recognize as a cold.

In other words, Listerine Antiseptic attacks hosts of these germs on mouth and throat surfaces before they attack you.

Fewer Colds, Tests Showed

Such germicidal action perhaps explains Listerine Antiseptic's remarkable record against colds in tests made over a period of 12 years. Note these impressive results:

That regular twice-a-day Listerine Antiseptic users had fewer colds and fewer sore throats than non-users, and that when colds did develop, they were usually less severe and shorter-lived than those of non-users.

Isn't that something to remember when you feel a cold coming on?

LAMBERT PHARMACAL CO., *St. Louis, Mo.*

Note how Listerine Antiseptic reduced germs

At left is illustrated the height of range in germ reductions on mouth and throat surfaces noted in test cases before and after gargling Listerine Antiseptic. Actual tests showed reductions of surface bacteria ranging up to 96.7% fifteen minutes after the Listerine Antiseptic gargle, and up to 80% one hour after.

OUT OF ONE ARMY

and INTO ANOTHER

That's the story of many of the more than a million men who have received their honorable discharges. If you are one of them, you're interested in stepping up your "fire power" on the industrial front . . . continuing as the service man's partner in victory.

You can do that with an I. C. S. Course. At the same time you improve your chances for success in tomorrow's world.

As you know, I. C. S. is helping our Armed Forces train thousands of soldiers, sailors, marines and coast guards in skilled technical work. That's in addition to our regular student body of 100,000.

This wide range is made possible by courses tailored to fit the individual. Included are many technical and business subjects of special interest to disabled veterans. Cost is low and there's a discount for *all* demobilized veterans. The coupon brings full information.

INTERNATIONAL CORRESPONDENCE SCHOOLS

ICS

BOX 4904-R, SCRANTON 9, PENNA.

Without cost or obligation, please send booklet and full particulars about course *before* which I have marked X:

Air Conditioning and Plumbing Schools
- ☐ Air Conditioning ☐ Heating
- ☐ Plumbing ☐ Refrigeration

Chemistry Schools
- ☐ Chemical Engineering
- ☐ Chemistry, Analytical
- ☐ Chemistry, Industrial
- ☐ Plastics
- ☐ Pulp and Paper Making

Civil Engineering, Architectural and Mining Schools
- ☐ Architecture
- ☐ Bridge Engineering
- ☐ Civil Engineering
- ☐ Coal Mining
- ☐ Contracting and Building
- ☐ Highway Engineering
- ☐ Lumber Dealer
- ☐ Sanitary Engineering
- ☐ Structural Drafting
- ☐ Surveying and Mapping

Electrical Schools
- ☐ Electrical Drafting
- ☐ Electrical Engineering
- ☐ Practical Electrician
- ☐ Practical Telephony
- ☐ Telegraph Engineering

Internal Combustion Engines School
- ☐ Auto Technician
- ☐ Aviation
- ☐ Diesel-Electric
- ☐ Diesel Engines
- ☐ Gas Engines

Mechanical Schools
- ☐ Aeronautical Engineering
- ☐ Airplane Drafting
- ☐ Foundry Work
- ☐ Heat Treatment of Metals
- ☐ Mechanical Drafting
- ☐ Mechanical Engineering
- ☐ Patternmaking
- ☐ Reading Shop Blueprints
- ☐ Shop Practice
- ☐ Tool Designing
- ☐ Welding, Gas & Electric

Radio School
- ☐ Electronics
- ☐ Radio, General
- ☐ Radio Operating

Railroad School
- ☐ Locomotive Engineer
- ☐ Locomotive Fireman
- ☐ Railroad Sec. Foreman

Steam Engineering School
- ☐ Boilermaking
- ☐ Combustion Engineering
- ☐ Marine Engines
- ☐ Steam Electric
- ☐ Steam Engines

Textile School
- ☐ Cotton Manufacturing
- ☐ Rayon Weaving
- ☐ Textile Designing
- ☐ Woolen Manufacturing

Business and Academic Schools
- ☐ Accounting
- ☐ Advertising
- ☐ Bookkeeping
- ☐ Business Correspondence
- ☐ Business Management
- ☐ Certified Pub. Account'g
- ☐ Commercial
- ☐ Cost Accounting
- ☐ Federal Tax
- ☐ Foremanship
- ☐ High School
- ☐ Illustrating
- ☐ Motor Traffic
- ☐ Salesmanship
- ☐ Secretarial
- ☐ Stenography
- ☐ Traffic Management

Language School
- ☐ French
- ☐ Spanish
- ☐ Good English

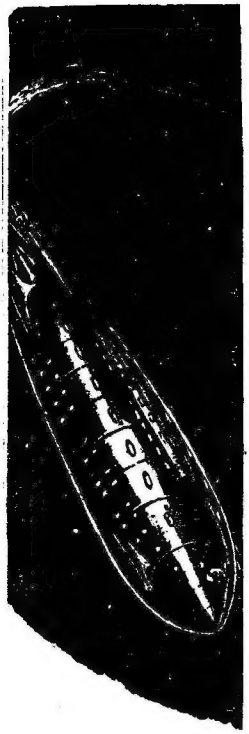
Name.....*Age*.....*Home Address*.....

City.....*State*.....*Present Position*.....*Working Hours*.....*A.M. to*.....*P.M.*

Canadian residents send coupon to International Correspondence Schools Canadian, Ltd., Montreal, Canada.
British residents send coupon to I. C. S., 71 Kingsway, London, W. C. 2, England.

Discount to Discharged Veterans; special tuition rates for members of the Armed Forces.

AST—1



ASTOUNDING SCIENCE FICTION

Reg. U. S. Pat. Off.

CONTENTS

JANUARY, 1945 VOL. XXXIV, NO. 5

NOVELETTE

THE MIXED MEN, *by A. E. van Vogt* 7

SHORT STORIES

THE CANAL BUILDERS, *by Robert Abernathy* . 33

ENTER THE PROFESSOR, *by E. Mayne Hull* . 45

THE WAVERIES, *by Frederic Brown* 126

SERIAL

NOMAD, *by Wesley Long* 65

Three Parts—Part Two

ARTICLES

SPECTRUM OF GENERATORS 99

THE PERFECT MACHINE, *by A. Bertram Chandler* 107

"THEY WERE DEAD . . . ," *by Willy Ley* . . 146

READERS' DEPARTMENTS

THE EDITOR'S PAGE 5

IN TIMES TO COME 32

THE ANALYTICAL LABORATORY . . . 64

BRASS TACKS 148

COVER BY TIMMINS

Illustrations by Orban and Williams

Editor
JOHN W. CAMPBELL, JR.

The editorial contents have not been published before, are protected by copyright and cannot be reprinted without publisher's permission. All stories in this magazine are fiction. No actual persons are designated by name or character. Any similarity is coincidental.

Monthly publication issued by Street & Smith Publications, Incorporated, 122 East 42nd Street, New York 17, N. Y. Allen L. Grammer, President; Gerald H. Smith, Vice President and Treasurer; Henry W. Ralston, Vice President and Secretary. Copyright, 1944, in U. S. A. and Great Britain by Street & Smith Publications, Inc. Reentered as Second-class Matter, February 7, 1938, at the Post Office at New York, under Act of Congress of March 3, 1879. Subscriptions to Countries in Pan American Union, $2.75 per year; elsewhere, $3.25 per year. We cannot accept responsibility for unsolicited manuscripts or artwork. Any material submitted must include return postage.

$2.50 per Year in U. S. A. Printed in [illegible] 199 the U. S. A. 25c per Copy

NEXT ISSUE ON SALE JANUARY 16, 1945

"The Next Decimal Place"

There's a fairly well-known story of the Victorian-era physicist who advised a friend against having his son study physics, explaining that "There's nothing for the next generation of physicists to do except measure the next decimal place." Nothing really important, everything fundamental has already been done.

The curious thing about it is that the statement was perfectly correct; the next generation of physicists did do nothing but check the next decimal point. Planck developed the quantum theory, that led to Bohr's atomic structure work, because, when he set up accurate—really accurate—methods for measuring the energy distribution in the spectrum of a black body, Planck discovered that it simply didn't, and couldn't be hornswoggled into fitting the classical theories. The next decimal place, in other words, wouldn't fit at all.

The Michaelson-Morley experiment, proving that there was no such thing as absolute motion by measuring the speed of light traveling in different directions was a "next decimal place" too. You had to be able to measure the speed of light to the last mile per second to find that answer.

The old boy was right; our greatest modern physicists are, as he truly said, engaged merely in measuring the next decimal place. Einstein for instance. Of course, he developed his theories from other data — Planck's measurements, Bohr's theories, the Michaelson-Morley experiment—but his own mathematics was proven out by some extremely delicate decimal-place measuring. The displacement of a star seen around the edge of the Sun during total eclipse—a displacement that's very much a matter of accurate measurement of the next decimal place.

The old boy was wrong in his implications, of course. He hadn't the foggiest notion of what tremendous meaning can be hidden in that experimental error decimal place. A completely haywire theory that staggers along in fairly competent fashion so long as accurate data cannot be obtained will appear sour only when the next decimal place is available. The Ptolmaic theory of cosmology was fine, as accurate as naked-eye observation could make it. Cycles and epicycles could, and did, predict accurately the past and future positions of the planets. Accurately as they could be observed without a telescope, at least. It was the next decimal place that inverted that set-up with a resounding crash.

Chemistry has the same sort of problems. The atomic weight of hydrogen was taken as 1.00000 for a considerable time. Finally, they made oxygen the standard set at 16.00000, so that hydrogen came out 1.008, but helium came out 4.000 —which happens to be much nearer the truth. There's tremendous sig-

nificance in that .008 in hydrogen's atomic weight; the whole universe is lighted, heated, and consumed by it. Which became apparent, of course, only after methods for really nailing down the full four significant figures became available.

Obviously, the next question is going to involve the next set of decimal places. Gravity is too little understood. So are magnetic field phenomena. There's plenty of reason for believing that a better method of determining the basic constants of physics would help a lot—better apparatus, better techniques, new approaches to the problems.

Sometimes it's hard to realize the importance of seemingly irrelevant matters. A friend remarked the other day that electrical wiring hadn't changed much in fifty years. He happened to be referring to that magnificent scramble you see inside a home radio receiver. Looks a good bit like the back of a telephone switchboard, except that the switchboard is a lot neater in appearance.

He also happened to be badly off the track. That haywire scramble of wires in a radio receiver is very carefully engineered. It's remarkable how a set will ululate if one or two of them are merely misplaced—not disconnected, or wrongly connected, but simply misplaced. Also, when radio amateurs first started on a large scale, they were kindly given a broad band of frequencies which nobody else wanted. (Nobody else wanted it, because the frequencies were so high that no practicable, large-scale equipment could be made to operate.) Shortly thereafter, the hams were moved along to still higher frequencies; they'd done a wonderful job of figuring out why the high frequencies didn't work, and developing methods of making them work. They've been moving to higher and higher frequencies steadily, developing more and more ingenious ways of doing what couldn't be done.

Of course tube design and efficiency had a lot to do with their success, but the real answer—the tubes were redesigned because the hams found out that answer—was that the wiring caused the trouble. Wiring hasn't changed much in fifty years? The hams, even before the war, were making "inductance coils" out of a U-shaped slab of sheet copper, and tuning transmitters with plumbing that looked like a slide trombone. Wiring the set was done with a hacksaw, and they measured the wave length with a yardstick and a flashlight bulb.

And Kirchoff, inventor of Kirchoff's Laws, would have gone quietly mad if someone handed him a radio-frequency ammeter, and a well-wired transmitter. "The sum of the currents flowing to a point in an electrical circuit equals the sum of the currents flowing from that point." He should have tried that on a length of copper pipe three feet long. Ten amperes flowing in: no amperes flowing out!

Somebody had slipped in another decimal point—the one behind which radio-frequencies lay hidden.

THE EDITOR.

The Mixed Men

by A. E. VAN VOGT

***It was** a mad sort of position for him; he was hereditary ruler of one side, and rightful ruler by marriage of the other. But both sides, distrusting him—used him as a pawn!*

Illustrated by Orban

The globe was palely luminous, and about three feet in diameter. It hung in the air at approximately the center of the room, and its lowest arc was at the level of Maltby's chin.

Frowning, his double mind tensed, he climbed farther out of the bed, put on his slippers, and walked slowly around the light-shape.

As he stepped past it, it vanished.

He twisted hastily back—and there it was again.

Maltby allowed himself a grim smile. It was as he had thought, a projection pointing out of sub-space at his bed, and having no material existence in the room. Therefore, it couldn't be seen from the rear.

His frown deepened with gathering puzzlement. If he didn't know that *they* did not possess such a communicator, he'd guess that he was about to be advised that the time had come for action.

He hoped not, fervently. He was as far as ever from a decision. Yet who else would be trying to reach him?

The impulse came to touch the button that would connect the control center of the big spaceship with what was going on in his room. It wouldn't do to have Gloria think that he was in secret communication with outsiders.

Maltby smiled grimly. If she ever got suspicious, even the fact that he was married to her wouldn't save his two minds from being investigated by the ship's psychologist, Lieutenant Neslor. Still—

He had other commitments than marriage. He sat down on the bed, scowled at the thing, and said:

"I'm going to make an assumption as to your identity. What do you want?"

A voice, a very strong, confident voice spoke *through* the globe:

"You think you know who is calling, in spite of the unusual means?"

Maltby recognized the voice. His eyes narrowed, he swallowed hard; then he had control of himself. Memory came that there might be other listeners, who would draw accurate conclusions from his instant recognition of a voice. It was for them that he said:

"The logic of it is comparatively simple. I am a Mixed Man aboard the Earth battleship *Star Cluster,* which is cruising in the Fifty Suns region of the Lesser Magellanic Cloud. Who would be trying to get in touch with me but the Hidden Ones of my own race?"

"Knowing this," said the voice pointedly, "you have nevertheless made no attempt to betray us?"

Maltby was silent. He wasn't sure he liked that remark. Like his own words, he recognized that these were aimed at possible listeners. But it was not a friendly act to call the attention of those listeners to the fact that he *was* keeping this conversation to himself.

More sharply than before it struck him that he had better remember his political situation both here on the ship, and out there. And weigh every word as he uttered it.

Born a Mixed Man, Maltby had been captured as a child by the Dellian and non-Dellian robots of the Fifty Suns, and educated to a point where he felt a semiloyalty to his captors. Years of a life in which he was never quite trusted had culminated in his being assigned to destroy the Earth battleship.

In this he had only been partially successful, the end result having been a forcible re-shaping of his minds to be sympathetic to Earth. And this, in its turn, had ended in marriage to the youthful and dynamic Lady Laurr, commander of the mightiest war machine that had ever entered the Lesser Magellanic Cloud.

As a result of his varied experience, he now had three sympathies.

That was the trouble. *Three* sympathies. He understood the motivations and beliefs, not only of the Dellian and non-Dellian robots, but also of the hidden race of Mixed Men and of the human beings from the main galaxy.

Literally, he couldn't take sides *against* any of them. His only hope, long held now, was that somewhere amid the welter of conflicting fears and desires was a solution that would be satisfactory to all three groups.

He knew better than to expect that such a hope would occur to any of the three. It was time he spoke again, and it would be advisable to bring the identity of the man beyond the light-thing into the open. He stared at it, and said curtly:

"Who are you?"

"Hunston!"

"Oh!" said Maltby.

His surprise was not altogether simulated. There was a difference between an inward recognition of a voice, and having that recognition verbally verified. The implications of the identity somehow sank in deeper:

Hunston, his enemy among the Mixed Men, and for many years now the acting leader.

Softly, Maltby repeated an earlier question: "What do vou want?"

"Your diplomatic support."

Maltby said: "My what?"

The voice grew resonant and proud:

"In accordance with our belief, which you must surely share, that the Mixed Men are entitled to an equal part in the government of the Fifty Suns, regardless of the smallness of their numbers, I have today ordered that control be seized of every planet in the System. At this moment the armies of the Mixed Men, backed by the greatest assembly of super-weapons known in any galaxy, are carrying out landing operations, and will shortly attain control. You—"

The voice paused; then quietly: "You are following me, Captain Maltby?"

The question was like the silence after a clap of thunder.

Slowly, Maltby emerged from the hard shock of the news. He climbed to his feet, then sank back again. Consciousness came finally that, though the world had changed, the room was still there. The room and the light-globe and himself.

Anger came then like a leaping fire. Savagely, he snapped:

"*You* gave this order—"

He caught himself. His brain geared to lightning comprehension, he examined the implications of the information. At last, with a bleak realization that in his position he could not argue the matter, he said:

"You're depending on acceptance of a *fait accompli*. What I know of the unalterable policies of Imperial Earth, convinces me your hope is vain."

"On the contrary," came the quick reply. "Only Grand Captain, the Lady Laurr must be persuaded. She has full authority to act as she sees fit. And she is your wife."

Cooler now, Maltby hesitated. It was interesting that Hunston, hav-

ing acted on his own, was now seeking his support. Not too interesting though. What really held Maltby silent was the sudden realization that he had *known* something like this would happen—had known it from the very instant the news had been flashed that an Earth battleship had discovered the robot civilization of the Fifty Suns many months ago now.

Ten years, five years, even one year hence, the seal of Earth's approval would be set forever on the Fifty Suns democratic system *as it was*.

And the laws of that government expressly excluded the Mixed Men from any participation whatsoever. At this moment, this month, a change was still theoretically possible. After that—

It was clear that he personally had been too slow in making up his mind. The passions of other men had surged to thoughts of action, and finally to action itself. He would have to leave the ship somehow, and find out what was going on. For the moment, however, caution was the word. Maltby said:

"I am not averse to presenting your arguments to my wife. But some of your statements do not impress me in the slightest. You have said 'the greatest assembly of superweapons in any galaxy.' I admit this method of using sub-space radio is new to me, but your statement as a whole must be nonsense.

"You cannot possibly know the weapons possessed by even this one battleship because, in spite of all my opportunity, I don't know. It is a safe assumption, furthermore, that no one ship can carry some of the larger weapons that Earth could muster at short notice anywhere in the charted universe.

"You cannot, isolated as we have all been, so much as guess what those weapons are, let alone declare with certainty that yours are better. Therefore, my question in that connection is this: why did you even mention such an implied threat? Of all your arguments, it is the least likely to rouse any enthusiasm for your cause. Well?"

On the main bridge of the big ship, the Right Honorable Gloria Cecily turned from the viewing plate, which showed Maltby's room. Her fine face was crinkled with thought. She said slowly to the other woman:

"What do you make of it, Lieutenant Neslor?"

The ship's psychologist said steadily: "I think, noble lady, this is the moment we discussed when you first asked me what would be the psychological effects of your marriage to Peter Maltby."

The grand captain stared at her subordinate in astonishment. "Are you mad? His reaction has been correct in every detail. He has told me at great length his opinions of the situation in the Fifty Suns; and every word he has spoken fits. He—"

There was a soft buzz from the intership radio. A man's head and shoulders came onto the plate. He said:

"Draydon, Commander of Com-

munications speaking. In reference to your question about the ultra-wave radio now focused in your husband's bedroom, a similar device was invented in the main galaxy about a hundred and ninety years ago. The intention was to install it into all the new warships, and into all the older ships above cruiser size, but we were on our way before mass production began.

"In this field at least, therefore, the Mixed Men have equaled the greatest inventions of human creative genius, though it is difficult to know how so few could accomplish so much. The very smallness of their numbers makes it highly probable that they are not aware that our finders would instantly report the presence of their energy manifestation. They cannot possibly have discovered all the by-products of their invention. Any questions, noble lady?"

"Yes, how does it work?"

"Power. Sheer, unadulterated power. The ultra rays are directed in a great cone towards a wide sector of space in which the receiver ship is believed to be. Every engine in the sending ship is geared to the ray. I believe that experimentally contact was established over distances as great as thirty-five hundred light-years."

"Yes, but what is the principle?" Impatiently. "How, for instance, would they pick out the *Star Cluster* from a hundred other battleships?"

"As you know," came the reply, "our battleship constantly emits identification rays, on a special wave length. The ultra rays are tuned to that wave length, and when they contact, react literally instantaneously. Immediately, all the rays focus on the center of the source of the identification waves, and remain focused regardless of speed or change of direction.

"Naturally, once the carrier wave is focused, sending picture and voice beams over it is simplicity itself."

"I see." She looked thoughtful. "Thank you."

The grand captain clicked off the connection, and turned again to the image of the scene in Maltby's room. She heard her husband say:

"Very well, I shall present your arguments to my wife."

The answer of the light-globe was: it vanished. She sat cold. The whole interview had been registered on a beam; and so the part she had missed didn't matter. She'd run it off again later. She turned slowly to Lieutenant Neslor, and expressed the thought that hadn't left her mind for an instant:

"What are your reasons for what you said just before we were interrupted?"

The older woman said coolly: "What has happened here is basic to the entire robot problem. It is too important to allow any interference. Your husband must be removed from the ship, and you must allow yourself to be conditioned out of love with him until this affair is finally settled. You see that, don't you?"

"No!" Stubbornly. "I do not. On what do you base your opinion?"

"There are several notable points," said the psychologist. "One of them is the fact that *you* married him. Madam, you would never have married an ordinary person."

"Naturally." The grand captain spoke proudly. "You yourself have stated that his I.Q.'s, both of them, are greater than mine."

Lieutenant Neslor laughed scathingly. "Since when has I.Q. mattered to you? If that was a reason for recognizing equality, then the royal and noble families of the galaxy would long ago have become saturated with professors and scholars. No, no, my captain, there is in a person born to high estate an instinctive sense of greatness which has nothing to do with intelligence or ability. We less fortunate mortals may feel that that is unfair, but there is nothing we can do about it. When his lordship walks into the room, we may dislike him, hate him, ignore him or kowtow to him. But we are never indifferent to him.

"Captain Maltby has that air. You may not have been consciously aware of it when you married him, but you were, subconsciously."

The young woman protested: "But he's only a captain in the Fifty Suns navy, and he was an orphan raised by the state."

Lieutenant Neslor was cool. "He knows who he is, make no mistake. My only regret is that you married him so swiftly, thus barring me from making a detailed examination of his two minds. I am very curious about his history."

"He has told me everything."

"Noble lady," said the psychologist sharply. "Examine what you are saying. We are dealing with a man whose lowest I.Q. is more than 170. Every word you have spoken about him shows the bias of a woman for her lover.

"I am not," Lieutenant Neslor finished, "questioning your basic faith in him. As far as I have been able to determine he is an able and honest man. But your final decisions about the Fifty Suns must be made without reference to your emotional life. Do you see now?"

There was a long pause, and then an almost imperceptible nod. And then:

"Put him off," she said in a drab voice, "at Atmion. We must turn back to Cassidor."

Maltby stood on the ground, and watched the *Star Cluster* fade into the blue mist of the upper sky. Then he turned, and caught a ground car to the nearest hotel. From there he made his first call. In an hour a young woman arrived. She saluted stiffly as she came into his presence. But as he stood watching her some of the hostility went out of her. She came forward, knelt gingerly, and kissed his hand.

"You may rise," Maltby said.

She stood up, and retreated, watching him with alert, faintly amused, faintly defiant gaze.

Maltby felt sardonic about it himself. Earlier generations of Mixed Men had decided that the only solution to leadership among so many immensely able men was an hereditary rulership. That decision had

backfired somewhat when Peter Maltby, the only son of the last active hereditary leader, had been captured by the Dellians in the same battle that had killed his father. After long consideration, the lesser leaders had decided to reaffirm his rights.

They had even begun to believe that it would be of benefit to the Mixed Men to have their leader grow up among the people of the Fifty Suns. Particularly since good behavior on his part and by the other captured, now grown-up children, might be a way of winning back the good opinion of the Fifty Suns' people.

Some of the older leaders actually considered that the only hope of the race.

It was interesting to know that, in spite of Hunston's action, one woman partially recognized his status. Maltby said:

"My situation is this: I am wearing a suit which, I am convinced, is tuned to a finder on the *Star Cluster*. I want someone to wear it while I go to *the* hidden city."

The young woman inclined her head. "I am sure that can be arranged. The ship will come at midnight tomorrow to the rendezvous. Can you make it?"

"I'll be there."

The young woman hesitated. "Is there anything else?"

"Yes," said Maltby, "who's backing Hunston?"

"The young men." She spoke without hesitation.

"What about the young women?"

She smiled at that. "I'm here, am I not?"

"Yes, but only with half your heart."

"The other half," she said, unsmiling now, "is with a young man who is fighting in one of Hunston's armies."

"Why isn't your whole heart there?"

"Because I don't believe in deserting a system of government at the first crisis. We chose hereditary leadership for a definite period. We women do not altogether approve of these impulsive adventures, led by adventurers like Hunston, though we recognize that this is a crisis."

Maltby said gravely: "There will be many dead men before this is over. I hope your young man is not among them."

"Thank you," said the young woman. And went out.

There were nine nameless planets, nine hidden cities where the Mixed Men lived. Like the planets, the cities had no names. They were referred to with a very subtle accent on the article in the phrase *"the* city." *The!* In every case the cities were located underground, three of them beneath great, restless seas, two under mountain ranges, the other four—no one knew.

Actually, no one knew. The outlets were far from the cities, the tunnels that led to them wound so tortuously that the biggest spaceships had to proceed at very low speeds around the curves.

The ship that came for Maltby

was only ten minutes late. It was operated mostly by women, but there were some older men along, including three of his long-dead father's chief advisers, fine-looking old men named Johnson, Saunders and Collings. Collings acted as spokesman:

"I'm not sure, sir, that you should come to *the* city. There is a certain hostility, even among the women. They are afraid for their sons, husbands and sweethearts, but loyal to them.

"All the actions of Hunston and the others have been secret. For months we have had no idea what is going on. There is positively no information to be had at *the* hidden city."

Maltby said: "I didn't expect there would be. I want to give a speech, outlining the general picture as I see it."

There was no clapping. The audience—there were about twenty thousand in the massive auditorium—heard his words in a silence that seemed to grow more intense as he described some of the weapons on board the *Star Cluster,* and the policies of Imperial Earth with respect to lost colonies like the Fifty Suns.

He knew the verbal picture he was drawing was not pleasing them, but he finished grimly:

"My conclusion is this: Unless the Mixed Men can arrive at some agreement with Earth, or discover some means of nullifying the power of Earth, then all the preliminary victories are futile, meaningless and certain to end in disaster. There is no power in the Fifty Suns strong enough to defeat the battleship *Star Cluster* let alone all the other ships that Earth could send here in an emergency. Therefore—"

He was cut off. All over the great hall, mechanical speakers shouted in unison:

"He's a spy for his Earth wife. He never was one of us."

Maltby smiled darkly. So Hunston's friends had decided his sobering arguments might get him somewhere, and this was their answer.

He waited for the mechanized interruptions to end. In vain! The minutes flew by, and the bedlam grew rather than lessened. The audience was not the kind that approved of noise as a logical form of argument. As Maltby watched, several angry young women tore down reachable loud-speakers. Since many were in the ceiling, it was not a general solution. The confusion increased.

Tensely, Maltby thought: They must know, Hunston and his men, that they were irritating their followers here. How did they dare take the risk?

The answer came like a flash: They were playing for time. They had something big up their collective sleeve, something that would overwhelm all irritation and all opposition.

A hand was tugging at his arm. Maltby turned. And saw that it was Collings. The old man looked anxious.

"I don't like this," he said urgently above the uproar. "If they'll go this far, then they might even

dare to assassinate you. Perhaps you had better return at once to Atmion, or Cassidor, wherever you wish to go."

Maltby stood thoughtful. "It has to be Atmion," he said finally. "I don't want the people aboard the *Star Cluster* to suspect that I have been wandering. In one sense I no longer have any commitments there, but I think the contact might still be valuable."

He smiled wryly, because that was an understatement if there ever was one. It was true that Gloria had been conditioned out of love with him, but he had been left conditioned *in* love with her. No matter how hard he tried he couldn't dismiss the reality of that.

He spoke again: "You know how to get in touch with me if anything turns up."

That, too, was to laugh. He had a pretty shrewd idea that Hunston would make particularly certain that no information came to *the* hidden city on *the* nameless planet.

Just how he was going to obtain information was another matter.

Quite suddenly, he felt completely cast out. Like a pariah, he left the stage. The noise faded behind him.

He wandered out the days; and the puzzling thing to Maltby was that he heard nothing about the *Star Cluster*. For a month of hours, he went aimlessly from city to city; and the only news that came through was of the success of the Mixed Men.

Highly colored news it was. Everywhere, the conquerors must have seized radio control; and glowing accounts came of how the inhabitants of the Fifty Suns were wildly acclaiming their new rulers as leaders in the fight against the battleship from Imperial Earth. Against the human beings whose ancestors fifteen thousand years before had massacred all robots they could find, forcing the survivors to flee to this remote cloud of stars.

Over and over the theme repeated. No robot could ever trust a human being after what had happened in the past. The Mixed Men would save the robot world from the untrustworthy human beings and their battleship.

A very unsettling and chilling note of triumph entered the account every time the battleship was mentioned.

Maltby frowned over that, not for the first time, as he ate his lunch in an open-air restaurant on the thirty-first day. Soft, though vibrant music, poured over his head from a public announcer system. It was almost literally *over* his head, because he was too intent to be more than dimly aware of outside sound. One question dominated his thought:

What had happened to the battleship *Star Cluster?* Where *could* it be?

Gloria had said: "We shall take immediate action. Earth recognizes no governments by minorities. The Mixed Men will be given democratic privileges and equality, not dominance. That is final."

It was also, Maltby realized, reasonable IF human beings had really

gotten over their prejudice against robots. It was a big if; and their prompt unloading of him from the ship proved that it wasn't a settled problem by any means.

The thought ended, as, above him, the music faded out on a high-pitched note. The brief silence was broken by the unmistakable voice of Hunston:

"To all the people of the Fifty Suns, I make this important announcement: The Earth battleship is a danger no more. It has been captured by a skillful trick of the Mixed Men and it is at Cassidor, where it is even now yielding its many secrets to the technical experts of the Mixed Men.

"People of the Fifty Suns, the days of strain and uncertainty are over. Your affairs will in future be administered by your kin and protectors, the Mixed Men. As their and your leader, I herewith dedicate the thirty billion inhabitants of our seventy planets to the task of preparing for future visitations from the main galaxy, and of insuring that no warship will ever again venture far into the Lesser Magellanic Cloud, which we now

solemnly proclaim to be our living space, sacred and inviolable forever.

"But that is for the future. For the moment, we the people of the Fifty Suns have successfully circumvented the most hideous danger of our history. A three-day celebration is accordingly declared. I decree music, feasting and laughter—"

At first there seemed nothing to think. Maltby walked along a boulevard of trees and flowers and fine homes; and, after a while, his mind tried to form a picture of an invincible battleship captured with all on board—if they were still alive.

How had it been done. By all the blackness in space, *how?*

Mixed Men, with their hypnotically powerful double minds, if allowed aboard in sufficient numbers to seize mental control of all high officers, could have done it.

But who would be mad enough to let that first group get into the ship?

Until a month ago, the *Star Cluster* had had two protections at least against such a disastrous finale to its long voyage. The first was the ship's able psychologist, Lieutenant Neslor, who would unhesitatingly pry into the brain of every person who entered the machine.

The second safeguard was Captain Peter Maltby, whose double brain would instantly recognize the presence of another Mixed Man.

Only Maltby was not on the ship, but walking along this quiet, magnificent street, consuming himself with amazement and dismay. He was here because—

Maltby sighed with sudden immense understanding. So that was why the light-globe had appeared to him, and why Hunston had been so plausible. The man's words had had nothing to do with his intentions. The whole act had been designed to force off of the ship the one man who would instantly sense the presence of Mixed Men.

It was difficult to know what he would have done if he had discovered them. To betray one's kin to death for the love of an alien woman, was almost unthinkable.

Yet he couldn't have allowed *her* ship to be captured.

Perhaps, his course would have been to warn the would-be conquerors to keep away.

The choice, forced upon him at the flash moment of attack, would have taxed the logic capacity of his brain.

It didn't matter now. The events had fallen their chance ways without reference to him. He couldn't change the larger aspect of them: The political seizure of the Fifty Suns government, the capture of a mighty battleship, all these were beyond the influence of a man who had been proved wrong by events, and who could now be killed without anybody, even his former supporters, worrying too much about him.

It wouldn't do to contact *the* hidden city in this hour of Hunston's triumph.

There remained a fact that he had to do something about. The fact that if the *Star Cluster* had

been captured, then so had the Right Honorable Gloria Cecily. And the Lady Laurr of Noble Laurr was in addition to all her great titles Mrs. Peter Maltby.

That was the reality. Out of it grew the first purely personal purpose of his lonely life.

The naval yard spread before him. Maltby paused on the sidewalk a hundred feet from the main officers' entrance, and casually lighted a cigarette.

Smoking was primarily a non-Dellian habit; and he had never contracted it. But a man who wanted to get from planet IV of the Atmion sun to Cassidor VII without going by regular ship needed a flexible pattern of small actions to cover such moments as this.

He lit the cigarette, the while his gaze took in the gate and the officer in charge of the guard. He walked forward finally with the easy stride of a person of clear conscience.

He stood, puffing, while the man, a Dellian, examined his perfectly honest credentials. The casualness was a mask. He was thinking, in a mental sweat: It *would* be a Dellian. With such a man hypnotism, except under certain conditions of surprise, was almost impossible.

The officer broke the silence. "Step over to the postern, captain," he said. "I want to talk to you."

Maltby's primary mind sagged, but his secondary brain grew as alert as steel suddenly subjected to strain.

Was this discovery?

On the verge of slashing forth with his minds, he hesitated. Wait! he warned himself. Time enough to act if an attempt was made to sound an alarm. He must test to the limit his theory that Hunston wouldn't have had time to close all the gates against him.

He glanced sharply at the other's face. But the typically handsome countenance of a Dellian robot was typically impassive. If this was discovery, it was already too late for his special brand of hypnotism.

The robot began in a low voice, without preamble:

"We have orders to pick you up, captain."

He paused; he stared curiously at Maltby, who probed cautiously with his minds, met an invincible barrier, and withdrew, defeated but nonplussed. So far there was nothing menacing.

Maltby studied the fellow narrowly. "Yes?" he said cautiously.

"If I let you in," the Dellian said, "and something happened, say, a ship disappeared, I'd be held responsible. But if I don't let you in, and you just walk away, no one will guess that you've been here."

He shrugged, smiled. "Simple, eh?"

Maltby stared at the man gloomily. "Thanks," he said. "But what's the idea?"

"We're undecided."

"About what?"

"About the Mixed Men. This business of their taking over the government is all very well. But the Fifty Suns navy does not forswear, or swear, allegiance in ten minutes. Besides, we're not sure

that Earth's offer was not an honest one."

"Why are you telling me this?" After all, I am physically a Mixed Man."

The robot smiled. "You've been thoroughly discussed in the mess halls, captain. We haven't forgotten that you were one of us for fifteen years. Though you may not have noticed it, we put you through many tests during that period."

"I noticed," said Maltby, his face dark with memory. "I had the impression that I must have failed the tests."

"You didn't."

There was silence. But Maltby felt a stirring of excitement. He had been so intent on his own troubles that the reaction of the people of the Fifty Suns to cataclysmic political change had scarcely touched him.

Come to think of it, he had noticed among civilians the same uncertainty as this officer was expressing.

There was no doubt at all, the Mixed Men had seized control at a beautifully timed psychological moment. But their victory wasn't final. There was still opportunity here for the purposes of others.

Maltby said simply: "I want to get to Cassidor to find out what has happened to my wife. How can I manage it?"

"The grand captain of the *Star Cluster* is really your wife! That wasn't propaganda?"

Maltby nodded. "She's really my wife."

"And she married you knowing you were a robot?"

Maltby said: "I spent weeks in the battleship's library looking up Earth's version of the massacre of the robots, which took place fifteen thousand years ago. Their explanation was that it was a brief revival in the mass of the people of old-time race prejudices which, as you know, were rooted in fear of the alien and, of course, in pure elemental antipathy.

"The Dellian robot was such a superbly handsome being, and with his curious physical and mental powers *seemed* to be superior to naturally born men that, in one jump, the fear became a panicky hate, and the lynchings began."

"What about the non-Dellian robots, who made possible the escape, and yet about whom so little is known?"

Maltby laughed grimly. "That is the cream of the jest. Listen—"

When he had finished his explanation, the officer said blankly:

"And do the people of the *Star Cluster* know this?"

"I told them," Maltby said. "They were intending to make the announcement just before the battleship went back to Earth."

There was silence. Finally the Dellian said: "What do you think of this business of Mixed Men seizing our government and organizing for war?"

"I'm undecided."

"Like the rest of us."

"What troubles me," said Maltby, "is that there are bound to be other Earth battleships arriving, and some

of them at least will not be captured by trickery."

"Yes," said the robot, "we've thought of that."

The silence settled, and lasted longer this time before Maltby brought out his request:

"Is there any way that I can get to Cassidor?"

The Dellian stood with closed eyes, hesitating. At last he sighed:

"There's a ship leaving in two hours. I doubt if Captain Terda Laird will object to your presence aboard. If you will follow me, captain."

Maltby went through the gate, and into the shadows of the great hangars beyond. There was an odd relaxedness inside him; and he was in space before he realized what it meant.

His taut sense of being alone in a universe of aliens was gone.

The darkness beyond the portholes was soothing to his creative brain. He sat staring into the black ink with its glinting brightness that were stars; and felt a oneness.

Nostalgic memory came of all the hours he had spent like this when he was a meteorologist in the Fifty Suns navy. Then he had thought himself friendless, cut off from these Dellian and non-Dellian robots by an unbridgeable suspicion.

The truth, perhaps, was that he had grown so aloof that no one had dared to try to close the gap.

Now, he knew the suspicion had long dimmed almost to vanishing. Somehow that made the whole Fifty Suns problem his again. He thought: a different approach to the rescue of Gloria was in order. A few hours before the landing, he sent his card to Captain Laird, and asked for an interview.

The commanding officer was a non-Dellian, lean and gray and dignified. And he agreed to every word, every detail of Maltby's plan.

"This whole matter," he said, "was threshed out three weeks ago, shortly after the Mixed Men seized power. In estimating the total number of warcraft available to Imperial Earth, we arrived at a figure that was almost meaningless, it was so large.

"It wouldn't be surprising," the officer continued earnestly, "if Earth could detach a warship for every man, woman and child in the Fifty Suns, and not perceptibly weaken the defenses of the main galaxy.

"We of the navy have been waiting anxiously for Hunston to make a statement either privately or publicly about that. His failure to do so is alarming, particularly as there is some logic in the argument that the first penetration of a new star system like our Lesser Magellanic Cloud, would be undertaken on the orders of the central executive."

"It's an Imperial mission," said Maltby, "working on a directive from the Emperor's council."

"Madness!" Captain Laird muttered. "Our new rulers are madmen."

He straightened, shaking his head, as if to clear it of darkness and confusion. He said in a resonant voice:

"Captain Maltby, I think I can

guarantee you the full support of the navy in your effort to rescue your wife if . . . if she is still alive."

As he fell through the darkness an hour later, down and down and down, Maltby forced the warming effects of that promise to dim the grim import of the final words.

Once, his old sardonicism surged like a stirred fire; and he thought ironically: almost incredible that only a few months had passed since circumstances had made it necessary for Lieutenant Neslor, the *Star Cluster*'s psychologist, to force on him an intense emotional attachment for Gloria; that attachment which, ever since, had been the ruling passion of his life.

She on the other hand had fallen for him naturally. Which was one of the reasons why their relationship was so precious.

The planet below was brighter, larger, a crescent sitting comfortably in space, its dark side sparkling with the silver flashing lights of tens of thousands of towns and cities.

That was where he headed, towards the twinkling dark side. He landed in a grove of trees; and he was burying his spacesuit beside a carefully marked tree, when the total blackness struck him.

Maltby felt himself falling over. He hit the ground with a sharp impact, distinctly aware of his consciousness fading out of his mind.

He woke up, amazed. And looked around him. It was still dark. Two of the three moons of Cassidor were well above the horizon; and they hadn't even been in sight when he landed. Their light shed vaguely over the small glade.

It was the same grove of trees.

Maltby moved his hands—and they moved; they were not tied. He sat up, then stood up.

He was alone.

There was not a sound, except the faint whispering of wind through the trees. He stood, eyes narrowed, suspicious; then, slowly, he relaxed. He had heard, he remembered suddenly, of unconsciousness like this overwhelming non-Dellians after a long fall through space. Dellians were not affected; and until this instant he had thought Mixed Men were also immune.

They weren't. There was no doubt about that.

He shrugged, and forgot about it. It took about ten minutes to walk to the nearest air stop. Ten minutes later he was at an air center.

He knew his way now. He paused in one of the forty entrances and, probing briefly with his two minds, satisfied himself that there were no Mixed Men among the masses of people surging towards the various escalators.

It was a tiny satisfaction at best. Tiny because he had known Hunston couldn't possibly spare the men for complicated patrol duty. The leader of the Mixed Men could talk as glibly as he pleased about his armies. But—Maltby smiled darkly—there was no such force.

The *coup d'etat* that had won Hunston control of the Fifty Suns was a far bolder, more risky accom-

plishment than was readily apparent. It must have been undertaken with less than a hundred thousand men—and the danger to Peter Maltby would be at the point of disembarkation at the mighty city Della, capital of the Fifty Suns.

He had just bought his ticket, and was striding towards a fourth level escalator when the woman touched his arm.

In a single flash, Maltby had her mind, then as swiftly he relaxed.

He found himself staring at Lieutenant Neslor, chief psychologist of the *Star Cluster.*

Maltby set down his cup, and stared unsmilingly across the table at the woman psychologist.

"Frankly," he said, "I am not interested in any plan you may have for recapturing the ship. I am in a position where I cannot conscientiously take sides on the larger issues."

He paused. He studied her curiously, but without any real thought. The emotional life of the middle-aged woman had puzzled him at times. In the past, he had wondered if she had used the machines in her laboratories to condition herself against all human feeling. The memory of that thought touched his brain as he sat there.

The memory faded. It was information he wanted, not addenda on her character.

He said, more coldly: "To my mind, you are responsible for the ignominious capture of the *Star Cluster,* first because it was you, in your scientific wisdom, who had me, a protective force, put off the ship; second because it was your duty to explore the minds of those who were permitted aboard. I still can't understand how you could have failed."

The woman was silent. Thin and graying at the temples, handsome in a mature fashion, she sat sipping her drink. She met his gaze finally, steadily. She said:

"I'm not going to offer any explanations. Defeat speaks for itself."

She broke off, flashed: "You think our noble lady will fall into your arms with gratitude when you rescue her. You forget that she has been conditioned out of love with you, and that only her ship matters to her."

"I'll take my chances on that, and I'll take it alone. And if we are ever again subject to Earth laws, I shall exercise my legal rights."

Lieutenant Neslor's eyes narrowed. "Oh," she said, "you know about that. You did spend a great deal of time in the library, didn't you?"

Maltby said quietly: "I probably know more about Earth laws than any other individual on the *Star Cluster.*"

"And you won't even listen to my plan, to use the thousand survivors to help in the rescue."

"I've told you, I cannot participate in the larger issues."

The woman stood up. "But you *are* going to try to rescue Lady Gloria?"

"Yes."

She turned without another word, and walked off. Maltby watched her until she disappeared through a distant door. After a moment there seemed nothing at all to think about the interview.

Grand Captain, the Right Honorable Gloria Cecily, the Lady Laurr of Noble Laurr, sat in the throne chair of her reception dais, and listened unsmilingly to the psychologist's report. It was not until the older woman had finished that the bleakness of the listener showed abatement.

Her voice, however, was sharp as she said:

"Then he definitely didn't suspect the truth? He didn't discover that the *Star Cluster* has never been captured. He didn't realize that it was you who made him unconscious when he landed in the grove of trees?"

Lieutenant Neslor said: "Oh, he was suspicious. But how could he so much as guess the larger truth? In view of our silence, how could he suspect that Hunston's triumphant announcement was only a part of the ever deadlier game he and we are playing, in our attempts to destroy each other? The very fact that Hunston *has* got an Earth battleship makes it particularly impossible for anybody to realize the truth?"

The young noblewoman nodded, smiling now. She sat for a moment, proud eyes narrowed with thought, lips parted, gleaming white teeth showing.

That had not been the expression on her face when first she had learned that the Mixed Men also had an Earth battleship, and a marvelously new model at that, a ship whose type had been in the design stage for nearly eight hundred years.

Sitting there, all the knowledge she had on the subject of that new thundership, as it was called in the naval yards, was flashingly reviewed in her mind. How its nine hundred billion separate parts had gone into mass production seventy-five years before, with the expectation that the first ship would be completed at the end of seventy years, and additional ones every minute thereafter for five years.

The five years were up. Very few of the vessels would actually be in service as yet, but somewhere along the line one of them had been stolen.

Her feelings concerning the possession by the Mixed Men of such a battleship had been an imbalance of relief and alarm. Relief that the super-inventions of the Mixed Men were after all only stolen from the main galaxy. And alarm at the implications of such a capture.

What were Hunston's intentions? How *did* he intend to get around the fact that Imperial Earth had more warships than there were men, women and children in the Fifty Suns?

She said slowly: "Undoubtedly, the Mixed Men sent a ship to the main galaxy the moment they heard about us; and, of course, if enough of them ever got aboard one of our warships there would be no stopping them."

She broke off, more cheerfully: "I am glad that Captain Maltby did not question your account of how you and a thousand other crew members escaped when Hunston made his so-called seizure of the *Star Cluster*. I am not surprised that he refused to have anything to do with your hare-brained scheme for recapturing the battleship.

"The important thing is that, under cover of this pretty little story, you learned what we wanted to know: His love fixation for me is driving him to an attempt to board Hunston's battleship. When the indicator we have had pointing at him since he left us at Atmion indicates that he is inside the ship, then we shall act."

She laughed. "He's going to be a very surprised young man when he discovers what kind of clothes he is wearing."

Lieutenant Neslor said: "He may be killed."

There was silence. But the faint smile remained on the finely molded, handsome face of Lady Laurr. Lieutenant Neslor said quickly:

"Do not forget that your present antagonism towards him is influenced by your present comprehension of how deeply you had previously committed yourself to an emotional attachment."

"It is possible," admitted the grand captain steadily, "that your conditioning was over enthusiastic. Whatever the reason, I have no desire to feel other than I do now. You may therefore consider this a command: Under no circumstances am I to be reconditioned into my former state.

"The divorce between Captain Maltby and myself, now that it has taken place, is final. Is that clear?"

"Yes, noble lady."

Here were ships. Ships, ships, ships, more than Maltby had ever seen in the Cassidor yards. The Fifty Suns navy was undoubtedly being demobilized as fast as the Mixed Men could manage it.

The ships stretched in ranks to the north, to the east, to the south, as far as the eye could see. They lay in their cradles in long, geometric rows. Here and there surface hangars and repair shops broke that measured rhythm of straight lines. But for the most part the buildings were underground, or rather, under sheeted plains of metal, hidden by a finely corrugated sea of translucent steel alloy.

The Earth battleship lay about four miles from the western entrance. The distance seemed to have no diminishing effect on its size.

It loomed colossal on the horizon, overshadowing the smaller ships, dominating the sky and the planet and the sections of city that spread beyond it. Nothing on Cassidor, nothing in the Fifty Suns system could begin to approach that mighty ship for size, for complication, for sheer appearance of power.

Even now, it seemed incredible to Maltby that so great a weapon, a machine that could destroy whole planets, had fallen intact into the hands of the Mixed Men, captured by a trick.

With an effort, Maltby drew his mind from that futile contemplation, and walked forward. He felt cold and steady and determined. The officer at the gate was a pleasant faced non-Dellian, who took him through, saying:

"There is an electronic matter transmitter focused from the ship's hold into the doorway of that building."

He motioned a hundred yards ahead and to one side, and went on:

"That will get you inside the battleship. Now, put this alarm device in your pocket."

Maltby accepted the tiny instrument curiously. It was an ordinary combination sending and receiving tube with a lock button to activate the signal.

"What's this for?" he asked.

"You're heading for the Grand Captain's bridge, are you not?"

Maltby nodded, but there was a thought beginning in his mind; and he did not trust himself to speak. He waited. The young man continued:

"As soon as you can, make every effort to go over to the control board and nullify energy flows, force connections, automatic screens and so on. Then press the signal."

The thought inside Maltby was an emptiness. He had a sudden

sense of walking along the edge of an abyss.

"But what's the idea?" he asked blankly.

The answer was quiet, almost cool. "It has been decided," said the young officer, "to try to take the battleship. We got hold of some spare transmitters, and we are ready to put a hundred thousand men aboard in one hour from the various concentration centers. Whatever the result, in the confusion of the attack your chances of escaping with your wife will be augmented."

He broke off crisply: "You understand your instructions?"

Instructions! So that was it. He was a member of the Fifty Suns navy, and they took it for granted that he was subject to orders without question.

He wasn't of course. As hereditary leader of the Mixed Men, who had sworn allegiance to the Fifty Suns, and married the representative of Imperial Earth, his loyalty was a problem in basic ethics.

The wry thought came to Maltby that only an attack by the survivors of the *Star Cluster* was needed now. Led by Lieutenant Neslor, their arrival would just about make a perfect situation for a man whose mind was running around in circles, faster and faster every minute.

He needed time to think, to decide. And, fortunately, the time was going to be available. *This* decision didn't have to be made here and now. He would take the alarm device—and sound it or not according to his determination at the moment.

Relieved, he slipped the instrument into his pocket. He said quietly:

"Yes, I understand my instructions."

Two minutes later he was inside the battleship.

The storeroom, in which Maltby found himself, was deserted. That shocked him. It was too good to be true.

His gaze flashed over the room. He couldn't remember ever having been in it when he was aboard the *Star Cluster*. But then he had never had any reason to wander all over the mighty ship. Nor, for that matter, had he had time.

The room was a storehouse, ordinary, without interest for him.

Maltby walked swiftly over to the inter-room transmitter, reached up to press the toucher that would enable him to step from the hold into the grand captain's bridge. But at the last instant, his fingers actually on the toucher, he hesitated.

It had been wise, of course, to do everything boldly. The whole history of warfare taught that planned boldness, tempered with alertness, weighed heavily in the balance of victory.

Only he hadn't really planned.

Consciously, he let his secondary, his Dellian mind tilt forward. He stood very still, mentally examining his actions from the moment that Hunston had projected the globe of force into his bedroom, through the trip to Cassidor, the talk he had had

with Lieutenant Neslor, and the suddenly announced attack plan of the Fifty Suns navy.

Thinking about it, it struck him sharply that the over-all, outstanding effect was of complication. The Dellian part of his brain, with its incisive logic, usually had little difficulty organizing seemingly unrelated facts into whatever unity was innate in them.

Yet now, it was slow in resolving the details. It took a moment to realize why: Each fact was a compound of many smaller facts, some of them partially resolvable by deduction, others though undoubtedly there, refused to come out of the mist.

There was no time to think about it. He had decided to enter the grand captain's cabin—and there was only one way to do it.

With an abrupt movement, he pressed the toucher. He stepped through into a brightly lighted room. A tall man was standing about a dozen feet from the transmitter, staring at it. In his fingers he held an In-no gun.

It was not until the man spoke that Maltby recognized Hunston. The leader of the Mixed Men said in a ringing voice:

"Welcome, Captain Maltby, I've been waiting for you."

For once, boldness had failed.

Maltby thought of snatching his own In-no gun from its holster. He thought of it, but that was all. Because, first, he glanced over at the control board, to the section that governed the automatic defenses of the interior of the ship.

A single light glowed there. He moved his hand slowly. The light flickered, showing awareness of him. He decided not to draw his weapon.

The possibility that that light would be on had made it highly inadvisable to enter the main bridge, weapon in hand.

Maltby sighed and gave his full attention to the other. It was seven years since he had seen Hunston. The man's physical development since then was worthy of attention. Like all men with Dellian blood in them, like Maltby himself, Hunston was a superbly well-proportioned being.

His mother must have been a blonde and his father a very dark brunette, because his hair had come out the curious mixture of gold and black that always resulted from such a union. His eyes were gray-blue.

Seven years before Hunston had been slenderer, and somehow immature in spite of his confidence and personality. That was all gone now. He looked strong and proud, and every inch a leader of men. He said without preamble:

"Briefly, the facts are these: This is not the *Star Cluster*. My statement about that was political maneuvering. We captured this battleship from a naval yard in the main galaxy. A second battleship, now in process of being captured, will soon be here. When it arrives, we shall engage the *Star Cluster* in a surprise attack."

The change of Maltby's status

from rescuer to dupe was as swift as that. One instant he was a man tensed with determination, geared to withstand any danger; the next a fool, his purpose made ludicrous.

He said: "B-but—"

It was a sound, not a reaction. A word expressing blankness, a thoughtless state, which preceded the mind storm, out of which grew understanding. Before Maltby could speak, Hunston said:

"Someone advised us that you were coming. We assume it was your wife. We assume furthermore that there is hostile purpose behind every move she is making. Accordingly, we prepared for any emergency. There are ten thousand Mixed Men inside this ship. If your arrival here is to be the signal for an attack, it will have to be well-organized indeed to surprise us."

Once more, there were too many facts. But after a moment, Maltby thought of the Fifty Suns navy men, waiting to enter the battleship, and flinched. He parted his lips to speak, and closed them again as his Dellian mind projected into his primary the memory of his meeting with Lieutenant Neslor.

The logic capacity of that secondary mind was on a plane that had no human parallel. There was a flashing connection made between the meeting with the psychologist and the blackness that had struck him down at the moment of his landing on Cassidor.

Instantly, that marvelous secondary brain examined a thousand possibilities, and, since it had enough clues at last, came forth with the answer.

The suit he was wearing!!! He must have been made unconscious, in order to substitute it for the one he *had* been wearing. Any minute, any *second,* it would be activated.

Sweating, Maltby pictured the resulting clash of titans: Ten thousand Mixed Men versus a major portion of the crew of the *Star Cluster* versus one hundred thousand men of the Fifty Suns navy.

If only that last group would wait for his signal, then he could save them by not sounding it. Sharp consciousness came that he ought to speak, but first—

He must find out if the suit had been energized.

He put his arm behind his back, and pushed his hand cautiously *into* his back. It went in four inches, six inches; and still there was only emptiness. Slowly, Maltby withdrew his arm.

The suit was activated all right.

Hunston said: "Our plan is to destroy the *Star Cluster,* then Earth itself."

"W-what?" said Maltby.

He stared. He had a sudden feeling that he had not heard correctly. He echoed, his voice loud in his own ears:

"Destroy Earth!"

Hunston nodded coolly. "It's the only logical course. If the one planet is destroyed, on which men know of the *Star Cluster*'s expedition to the Lesser Magellanic Cloud, then we shall have time to expand, to develop our civilization; and even-

tually, after a few hundred years of intensive breeding of Mixed Men, we will have enough population to take over the control of the main galaxy itself."

"But," Maltby protested, "Earth is the center of the main galaxy. All the government is there, the Imperial symbol. It's the *head* of the planets of 3000 million suns. It—"

He stopped. The fear that came was all the greater because it was not personal.

"Why, you madman!" he cried angrily. "You can't do a thing like that. It would disorganize the entire galaxy."

"Exactly." Hunston nodded with satisfaction. "We would definitely have the time we need. Even if others knew of the *Star Cluster* expedition, no one would connect it with the catastrophe, and no other expedition would be sent."

He paused. Then went on:

"As you see, I have been very frank with you. And you will not have failed to note that our entire plan depends on whether or not we can first destroy the *Star Cluster*. In this," he finished quietly, "we naturally expect the assistance of the hereditary leader of the Mixed Men."

There was silence in the great room. The bank on bank of control board remained impassive, except for the solitary anti-light that glowed like a faint beacon from its deep-inset tube.

Standing there, Maltby grew aware of a thought. It had only an indirect relation to the request Hunston had just made, and it wasn't new. He tried to fight it, but it remained strong, and grew stronger, a developing force in his mind. It was the conviction that he would yet have to take sides in this struggle of three powerful groups.

He couldn't allow Earth to be destroyed!

With a terrible effort, he finally forced the thought aside, and looked at Hunston. The man was staring at him with a narrow-eyed anxiety that abruptly startled Maltby.

He parted his lips to make a sardonic comment about a usurper who had the gall to ask help from the man he was striving to displace. But Hunston spoke first:

"Maltby—what is the danger? What is their plan in having you come here? You must know by this time."

Almost, Maltby had forgotten about that. Once more he was about to speak. But this time he stopped himself.

There was another thought forming in the back of his mind. It had been there for many months, and in its more detailed conception it was actually his solution to the whole Fifty Suns problem. In the past, the knowledge that the solution required one man to convince three groups, actually to control the three hostile groups at a given hour, and to force them to yield to his will, had made the whole idea ridiculous and impractical.

Now, in one mental jump, he saw

how it could be done. But hurry, hurry! Any instant the suit he was wearing would be used. He said violently:

"It's this room! If you value your life, get out of it at once."

Hunston stared at him, bright-eyed. He seemed unafraid. He asked in an interested tone:

"This room is the danger point because you're in it?"

"Yes," said Maltby—and held his arms out slightly, and his head up, so that the energy of Hunston's Inno gun would not hit them. His body tensed for the run forward.

Instead of shooting, Hunston frowned.

"There's something wrong. Naturally, I wouldn't leave you in charge of the control room of this battleship. Accordingly, you're practically asking me to kill you. It's obvious that if you're the danger, then you must die. Too obvious."

He added sharply: "That anti-light watching you—the moment I fire, its automatic defenses are nullified; and you can use a gun too. Is that what you're waiting for?"

It was.

All Maltby said was: "Get out of this room. Get out, you fool!"

Hunston did not move, but some of the color had faded from his cheeks. He said:

"The only danger we've been able to imagine is if somehow they managed to get a *Star Cluster* transmitter aboard."

He stared at Maltby. "We haven't been able as yet to figure out how those transmitters work, but we do know this: There is no liaison between the transmitters of one ship and another. They're tuned differently, and set. No amount of manipulation can change them, once completed. But YOU must have had opportunity to learn the secret of their operation. Tell me."

Tell me! It was clear now that he would have to attack in spite of the anti-light. That meant muscles only, which needed a fractional surprise. Starting to tell might do the trick.

But what an odd irony that Hunston and his technical experts had correctly reasoned out the exact nature of the danger. And yet now Hunston, standing in front of a man who was wearing a suit of clothes, both the back and front of which were transmitters, did not begin to suspect.

Maltby said: "Transmitters work in much the same way that the first Dellian robots were made, only they use the original components. The robot constructors took an electronic image of a human being, and constructed an exact duplicate from organic matter. Something was wrong of course because the Dellians never were mental duplicates of the original human beings, and there were even physical differences. Out of the difference grew the hatred that eventually resulted in the robot massacres of fifteen thousand years ago.

"But never mind that. These matter transmitters reduce the body to an electronic flow, transmit without loss, and then rebuild the body. The process has become as simple as turning on a light and—"

It was at that point that Maltby launched his attack.

The awful fear that Hunston would aim at his feet, arms or head, ended. Because in that ultimate moment, the man hesitated and like a thousand million men before him was lost.

The In-no gun did flash, as Maltby grabbed at the wrist of the hand that held it. But the fire sprayed harmlessly against the impregnable floor. And then the gun clattered out of the fight.

"You scoundrel!" Hunston gasped. "You knew I wouldn't fire on the hereditary leader of the Mixed Men. You traitor—"

Maltby had known nothing of the kind. And he did not waste time in consideration of it. Hunston's voice stopped because Maltby had his head in a vicelike grip, and was pulling it towards and *into* his chest. The surprise of that must have been staggering. For a vital moment Hunston ceased his struggling.

During that moment, Maltby stuffed him through the transmitter seemingly right into his own body.

Even as the last squirming foot was shoved out of sight, Maltby was tearing at the fasteners of the suit. He rolled the suit down, so that the transmitter surfaces faced one against the other.

Frantically, he climbed all the way out of the suit and, racing over to the control board, adjusted the anti-light to work *for* him, and made a dozen other adjustments that he knew about. A minute later, the ship was his.

There remained the necessity of telling the three groups *his* decision. And there remained—Gloria!

The Dellians and non-Dellians of the Fifty Suns accepted the decision the moment they realized the *Star Cluster* had not been captured by the Mixed Men, and that Earth guaranteed them protection.

The information that the non-Dellians were NOT robots at all but descendants of human beings who had helped the original robots to escape from the massacres did not have the sensational effect anticipated by Maltby. It merely made everything easier, to realize that human beings had pretended to be robots for the sake of subsequent generations; and that it had worked out all right.

The Mixed Men, their volatile leader Hunston a prisoner aboard the *Star Cluster,* agreed because Maltby was after all their hereditary chieftain, because their chances of ever capturing another battleship were zero, now that all ships in the main galaxy would be warned of their methods. And because their new status was that of complete equality within the government of the Fifty Suns, INCLUDING a guarantee that when a Dellian married a non-Dellian, the couple would no longer be forbidden to have children by the cold-pressure system.

Since the child resulting from such a union would invariably be a Mixed Man, it assured that ultimately and by legal and natural

development there would only be Mixed Men in the Fifty Suns—and eventually in the main galaxy, too.

On the tenth day, the captains in session aboard the *Star Cluster* sat on an entirely different case. The case of Grand Captain, the Right Honorable Gloria Cecily, the Lady Laurr of Noble Laurr, estranged from her husband, Peter Maltby, by psychological means because of an emergency.

The judgment handed down made intergalactic legal history. The judges held:

(1) That the law relating to the reintegration of artificially imposed psychological pressures did not apply to Captain Maltby, a non-citizen of Imperial Earth at the time he was conditioned, but does apply to the Lady Gloria, a citizen born.

(2) That since Captain Maltby has been made permanent agent to Earth for the Fifty Suns, and since this is the Lady Gloria's last trip into space on a warship, no geographical barriers exist to a continuation of the marriage.

(3) It is accordingly ordered that the Lady Gloria be given the necessary treatment to return her to her former condition of loving affection for her husband.

THE END.

IN TIMES TO COME

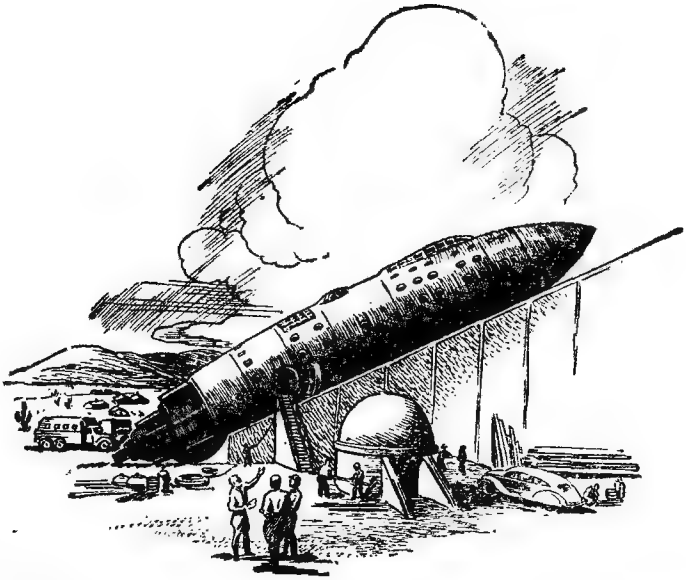
Lewis Padgett is back next month, with a lead story called "The Piper's Son." It's the first of a series Padgett discussed with me a while back—a series that is, I think, going to be extremely interesting. The first story itself, like any of Padgett's yarns, is more than good.

His new series has to do with a radically different cultural background—one vaguely like Simak's "City" series in one respect, the lack of cities, but wholly different in motivation. But the central theme is the position of the "Baldies" in that culture. The Baldies are a mutation—they're telepathic humans. Not supermen; they're pretty ordinary human beings, save for that one trait—and an accidental, rather meaningless linked mutation. They're a completely hairless race—hence the name.

Could such a people—mind readers, telepathically in communication with each other, but vastly inferior in numbers—live with normal humans? What jobs could they fill—without causing savage reaction from displaced non-telepaths?

Padgett's got an idea, and a story, and a background in this yarn, anyone of which would make for a pretty fair story. Together—they merit a series!

THE EDITOR



The Canal Builders

by ROBERT ABERNATHY

***They** could see, in their telescopes, geographical features of Mars. But their colonists who lived on Mars, reaching it through hyperspatial transmitters, coudn't find those features!*

Illustrated by Orban

"Do you want to laugh?" demanded Dave Barkley. "No? Well, get a load of this, anyway."

He thrust the newspaper under the nose of his companion in the bus seat, a jowled, middle-aged man who stared at it with a sour lack of interest.

"Hm-m-m," he said just as sourly. "Back on Earth, they've gone crazy yet."

"No question about it," agreed Dave cheerfully. He eyed the news item again and grinned. "A spaceship! And my own paper prints a story like that. I'll have to give Elders a talking to."

Dave enjoyed planning to give Elders a talking to, because Elders was his managing editor. So far, it had always worked the other way, though. The sour chap seemed un-

impressed, continued to gaze out the window across the aisle at the green luxury of the hydroponic farms rolling past. Plants brought from Earth grew there, but they exploded into wild new forms in the thin air and great temperature range of Mars. Above the fields of tenderer crops rose the mighty silvery standards of radiant heat lamps.

The bus slowed. "'Scuse me," mumbled Dave, getting to his feet and groping overhead for his respirator. "Here's where I get off."

"Hm-m-m," said the other, reaching for the newspaper Dave was abandoning.

After two minutes' walk, Dave Barkley was taking off his respirator mask once more in the anteroom of the *Martian Colonist's* editorial office. He was just zipping out of his insulated oversuit, as well, when Edgar, the office gremlin, came out to greet him, the pencil that was always behind his ear cocked at an angle that meant elation, which in turn meant that Edgar had news for somebody and hoped that it was bad. So far as Dave knew, that pencil served as nothing but an emotional indicator; he did not believe that Edgar could write. Nevertheless Edgar, due to a certain gift of omnipresence, was the boss' right arm.

Edgar flipped a thumb at the office. "The old man's in there yoining for you," he announced. "You better pick 'em up, bud."

Dave lifted both eyebrows. As a feature writer, one of the best on Mars, he was used to keeping bankers' hours. If Elders was going to start rushing him, he told himself, Elders would have to be talked to.

"Shut the door behind you," growled Elders. "Sit down and listen."

Dave decided that the talking-to would have to be postponed. He sensed that at the moment the livers were not propitious—his editor's liver, anyway, must have been acting up. Usually the latter's speech was deceptively mild.

Elders was talking jerkily. "Where have you been all morning? I sent you a call last night at eleven; you weren't in and I put it on the recorder. I told you to be here at six."

"I was—" began Dave slowly.

"Shut up," snapped Elders. "I don't care what honka-tonk you were in. Right now, you've got just two hours to get to Earth and out to the Yuma Desert. Here" —he leaned forward across his desk—"is your teleport ticket to Tucson, Arizona. There'll be a chartered plane waiting for you at the airport."

"Wait a minute!" gasped Dave. "If you've got a hot scoop, hand it to some bright young cub. Then, if you like, I'll write his facts up into a killer-diller feature. But I'm not—"

"You're going to Earth," said the editor, with something like his normal silky manner. "With or without a job. You know the law."

Dave knew the law. There were two ways to stay on Mars—with a visitor's permit, or as a permanent *working* resident. There was a retirement provision, too, for those

who wanted to stay after working age; but no one had yet been on Mars that long in the five years of colonization.

Elders had never held that particular club over Dave's head before. "Oh, oh," said the writer to himself. "This must be something big." Aloud he asked humbly, "Well, what is it?"

"I want you to come back to Mars on the Callahan rocket, and write a story about it. They wired only last night to say they'd like a Martian journalist on the flight."

"Rocket . . . huh?" Dave's eyes bulged. "You're kidding."

"I am not kidding," said Elders. "This is big stuff, Dave. Culmination of man's dream of achievement, and all that."

"You want me to be killed?"

Elders looked at him tenderly. "Do you think I'd risk my best feature writer . . . even if he is yellow . . . on a ship that wasn't as safe as your Granny's rocking chair? They've been working on this rocket stuff since before the second World War, thirty years before Ferency even dreamed up the mathematics that made the teleport. Now the problem's immensely simplified, of course; they know just where they're going and what landing conditions will be, they'll have a welcoming committee to meet them, and they don't have to carry fuel to get back. If you'd read the papers, you'd know what Callahan said in his last press interview: 'The actual flight to Mars is merely a matter of doing in practice what we have already perfected in theory. There isn't any chance or adventure left in it.' "

"Then what's the use of me going?" demanded Dave hopefully.

"You, my boy, are the one who's going to put in the adventure that ain't there. You're going to write about the first space trip like it was Dr. Livingstone finding the Congo."

"I've got acrophobia," protested Dave weakly. "I'll be so scared I won't even know what's going on."

"I know you'll be scared," answered Elders coolly. "You can write about how scared you were. The public will eat it up. Now, on your way." He extended the Earth ticket again; Dave took it numbly. "And," added his editor, with a penetrating look, "if you stop so much as thirty seconds to whistle at one of those Mexican tamales, I'll know it and have the oil boiling when you get back."

"If I get back," mumbled Dave, "the oil will look good." With the ticket clutched in his hand like a death sentence, he arose and stumbled out.

It didn't seem like anything, stepping through a little door in a teleport station in Aresia, and coming out in Arizona. Even though you knew that in doing so you walked through an interspace of barely-understood mathematics, that was something so far beyond the mind's grasp that it left your thalamus untroubled. But the idea of plunging across forty million miles of vacuum in a fire-spewing steel shell was another thing, a concept close

to the primal roots of fear. And it had never been done before.

The rocket builders, these smooth-faced young technicians who had gathered about Callahan, were so calm about it. They pointed out to Dave that the last year had been spent in perfecting anti-acceleration devices, to give the crew the maximum degree of protection and comfort during take-off and landing; that the ship had been flown repeatedly in tests beyond the atmosphere; that everything was on paper, down to the eleventh decimal and corrections for the expansion rate of the Universe.

He was talking to some of them when Callahan came into the concrete caisson that was built beside the launching tube, to shelter the workers who did not form the crew.

Despite the funk he was in, Dave sized Callahan up with a newsman's eye. The man was old with time and labor; most of a long lifetime had gone into the rocket that rested there above them. But there was a light in his sunken eyes that is seldom seen in the eyes of the aged. It was a light that made Dave feel queer.

Callahan came straight toward him, a big bent man, leaning heavily on a cane; his broad, flat fingers were twisted by arthritis. He spoke bluntly, in a voice that still had force.

"You're one of the newspaper men. Oh, yes—Mr. Barkley. Well, Mr. Barkley, whether you come back or not from this expedition, your name will be immortal in history. And I think we will all come back."

"We?" Dave stared. "I didn't suppose you were going, Dr. Callahan—"

The old man laughed, almost soundlessly. "After all these years of working and waiting, do you think I'll miss going to Mars? Certainly the doctors say the acceleration will kill me. But alive or dead, *I'm* going to be with the first men to land on another planet."

"The first men—" Dave stopped; one of the assistants, a young fellow named Dawson, had laid a hand on his arm and squeezed it hard and urgently. He swallowed, and looked hard at the old scientist.

"I understand perfectly," he managed to say.

"For fifty years," said Callahan, "I have wanted to be the one to conquer space. When I was a boy, I read imaginary tales of adventure on the other worlds. But there was something in me which was not satisfied with reading. I swore an oath to myself, by the holiness of science, that I would be the first seeker to land on Mars."

He passed on into the inner chamber, through the great steel doors that gave access to the rocket. Dave goggled at Dawson and passed a hand over his brow. It was hot in the caisson.

"Since the teleports were started," said Dawson. "He won't read the newspapers, won't hear of the Martian colonization. Nobody knows whether he's really insane or not—and nobody has the heart to find out."

"But when the ship gets to Mars," gulped Dave, "and the colonists come out with native-grown floral wreaths—"

"He'll not live to get there," said Dawson flatly. He shrugged his youthful shoulders, and he, too, turned toward the ship.

The ports were sealed with a stuff like rubber, a nameless new stuff that would remain air-tight alike at 1° K. or under the unshielded radiation of the Sun. Strapped and cushioned in for the acceleration, Dave Barkley had a sense of nightmare. He yearned frantically to be back on Mars, in the editorial office of the *Colonist,* with Elders shouting at him.

Abruptly the ship thundered and leaped. His heart staggered and darkness washed before his eyes. The wished-for image of Elders seemed to come out of the darkness, swelling to huge size and cursing him in a voice as of Apocalyptic trumpets. Dave passed out.

It was only a matter of moments, and he suffered abominably—more mentally than physically, to be sure—throughout the rest of the hours of terrific acceleration that took them off the Earth. For that matter, he suffered abominably during the rest of the flight as well—two weeks of hell. He developed an acute claustrophobia, something he had never felt before. The others seemed without emotions, mere extensions of the instruments they manipulated unweariedly. They hardly spoke, and that helped to madden Dave. The other newspaperman aboard, Carlson of the New York *Sun,* was just another man of iron like the rest. He took notes with a steady pencil; his most human remark was to wish to Heaven he had a typewriter.

It slowly became apparent, though, that they were going to make it; that is, if the rocket could land without smashing. It had done so before, in the Arizona desert. There would be a field leveled, near Aresia.

Often during those two weeks Dave crept laboriously up the ladder within the shell—up, because the acceleration continued at one Earth gravity to the midpoint of the trajectory, then the ship turned end for end, in a neat maneuver, to use its great stern rockets as brakes—up the ladder to the cabin where Callahan lay. At least the old man would talk, when his weakness let him, and, thought Dave, he was good society to go crazy in.

He heard over and over the story of Callahan's dreams, his trials and failures and successes. He heard his wheezing laughter of triumph as he prophesied that he would yet live to reach Mars.

"They wanted to bring along the embalming fluid to squirt into me after acceleration!" chortled Callahan feebly. "I told them, 'No, thank you. I'll stink as much as I please.'" He went off into a spasm of gasping chuckles. His old heart was throbbing irregularly now, like a worn and abused engine.

There came a time when Mars was only two days ahead, they told

him. It was always the same inside the ship, hot, stifling, with the rockets never silent in their steady rumble, slowing the projectile.

Dawson came down from the mobile observation turret, his eyes reddened from squinting through the six-inch refractor. His face looked puzzled, that was all; a sort of abstract scientific bewilderment.

He spoke to Peters, at the control panel: "That's funny. We should be able to see the light signals by now when it's night in Aresia."

Peters jerked his head around, his jaw dropping half an inch. "You can't see the signal?"

Dawson rubbed his blond-stubbled chin abstractedly. "Not a blink. It must be that the atmosphere has the qualities of one-way opacity suggested by Cooper to explain the apparent phenomenon of the 'canals,' whose nonexistence exploration has finally proved. But that's the funniest thing. I was about to tell you: the 'canals' show up from the turret as plain as the nose on your face."

"I want to see that," said Peters stonily. He flipped a switch, locking the controls, and went up into the turret with a scramble.

"What does that mean?" asked Dave Barkley fearfully, eying Dawson as if the latter had hydrophobia.

"Mean? Nothing much. Even if the signaling apparatus has gone haywire, or the atmosphere is too opaque, our course will carry us to Aresia with a probable error of not over fifty miles all ways. We can correct for that much in the stratosphere; we carry a small but adequate fuel reserve for that purpose, and we'll have a radio signal to guide us then."

"I see," said Dave, somewhat relieved.

"If you and Dr. Callahan get to talking again, don't mention this to him. Naturally, he's not expecting any signal."

"Sure," said Dave.

But it was not long thereafter that he realized they were afraid.

Those cool and certain young men, who could not crack because they knew exactly what the score was, were beginning to crack now. Their knowledge had failed them. He saw Dawson, now, with a blind look of near-panic in his eyes, mirroring the apparent blindness of the telescope. For, a scant two hundred thousand miles from Mars, they still saw nothing.

Nothing, that is, but the atmospheric illusion of the canals. Those dark streaks and stripes, geometrically crossing the great red disk, only grew plainer as they hurtled near. By now, Dawson admitted, they should be able to see the new-built works of man on Mars, his farms and roads and his cities of Aresia and Spaceport and Xanadu.

But there was nothing. Nothing —but they saw what seemed to be great tawny dust-whirls crossing the brick-colored surface. Those, too, which had been observed early in the present century, had long since been written off as upper-atmospheric phenomena. There were no dust storms on Mars; the deserts there, utterly barren of life, were

smooth wastes of red sandstone. Only where men had shattered the stone with explosives had the fossil desert become sand and soil again.

"We'll have to go ahead and land blind," said Dawson, passing a hand across his smarting eyes. There was something painful about the way he said the last word. These, thought Dave, were the men of science, the seeing men. I'm not much more scared than I was when I started. That's because I didn't know anything to begin with.

Callahan, in his cabin behind the control chamber, knew that they were approaching the red planet and could talk of nothing but of the nearness of his great triumph. He was sure, now, that he would live through the deceleration. He could not die yet.

When Dave was strapped into the cushions once more, and the brain-numbing thunder began, he thought of the old man up there, grappling with death by the strength of his will, and perhaps it was the thought of Callahan that gave him strength to remain conscious this time.

The spaceship plunged through emptiness toward a mystery-shrouded Mars. Dave hung on against the threatening darkness and the stifling heat that leaked through the insulation, and thought of the easy-chair and the long cool drink he would have in the Colonial Club in Aresia. And now, fortified by that drink and maybe some more, he would tell Elders just what he thought of that job.

After hours of that battle, the thrust of the drive waxed briefly, then fell off, and he knew they were not far from the surface. His stomach lurched as side thrusts swung the ship, but as it rode briefly on an even keel he could feel at last the blessed, steady pull of planetary gravity. Then, minutes later, the rocket teetered down, pillowed on flaming gases, to contact solidity once more.

The jar of landing set bells ringing in Dave's head; they had hardly stopped chiming when Peters was bending over his bunk to set him free of his protecting bonds. He could hear a sizzling sound, and a pungent smell of burning told him that someone was flaming open the ports.

Dave sat up as Peters unstrapped his legs, and mopped sweat out of his eyes. He asked limply, "Is Doc Callahan still—"

The other nodded briefly; he turned away, toward the flickering light of the torch that was burning away the seal, and spoke with an intensity of feeling that surprised Dave:

"I wish they'd hurry up and get that open. We couldn't observe after we started deceleration, and the radio beam didn't come through. We used our sending equipment to come in on soundings. But up to the last minute when we could use the telescope, we couldn't get the light signal or any familiar feature outside the polar cloud caps. And—those—canals—were—still—*there!*"

Dave straightened stiffened arms and legs; it was such sheer luxury to be able to move that he paid only

half attention to what the technician was saying. Then the port clanged open.

Peters, already wearing his Martian respirator, vanished toward the exit. When Dave got his on and wriggled through the three-foot opening in the air-tight shell, three of the five crew members were already standing on the Martian plain; Dawson was among them, but neither he nor any of the others even glanced around as Dave dropped to the ground on unsteady legs.

He looked at them, then followed their eyes, and froze as they had.

There, where the city of Aresia should have lain within view of their planned landing place, surrounded by its green fields and radiating white highways, was—a city. A city, yes, but a city in ruin. And they all stared as if paralyzed in the act of looking, for not only was it wholly, staggeringly unexpected, but—never before had man of Earth seen such a ruin.

To begin with, the city had been tremendous, and it was still a colossal shell. Above the rubble-mounds rose skeletons and splinters of what had been sky-pointing towers, buildings to rival the hugest skyscrapers of New York. Walls stood absurdly alone, gaping windows. Four-leveled traffic ways had fallen to add their debris to the stupendous wreck, and among the tangle were what might have been the remains of smashed vehicles. A tough and scanty vegetation grew here and there on sandy mounds.

The city began perhaps half a mile away across the desert, and the Martian air was clear. Every de-

tail stood out as if just before them, and wish as you might you could not doubt your eyes. Mirage? But a mirage is an image of something that exists elsewhere, and no such city existed anywhere.

Someone else came grunting through the port and dropped to the ground; it was Carlson, the New York newsman. When he saw the city he stopped short like the rest, but his arrival broke the spell on them. They stared at each other; it was Dawson who broke the silence, in a voice whose strained tenseness came even through the distortion of the thin Martian air:

"We must have missed our point of landing, and come down in some remote area. But those ruins—Barkley, you're from Mars; do you know anything about them?"

Dave shook his head, feeling incapable of speech.

"Then," put in another, "we must have come down in some region hitherto unexplored."

"Mars has been completely mapped from the air," Dave said, swallowing. "They couldn't have missed a landmark this size."

Carlson found his tongue. "That looks like a city that's been bombed," he said in an unbelieving voice. "Bombed with something that would make TNT look like a match sputtering."

Not far away, there was a chasm in the red desert that must have been easily a hundred feet across. For far around it the sand carpet was strewn with large and small masses of rock, split and shattered as if by a blast of titanic violence.

Someone else scrambled out the port, another of the boys of the crew. He, too, stopped and stared wide-eyed at the scene; then, at a call from within, he turned hastily, and with shaking hands helped maneuver a folding stretcher through the narrow opening. On it lay Callahan, his eyes half closed, on his seamed face a shadow of exhaustion and a light of victory.

But his eyes opened behind the respirator mask as they set him down on the red soil. Someone, even in that stunned moment, brought a cushion from the ship and put it behind his head so that he could sit up. Callahan saw the city, and he lay there quiescent, feasting his eyes upon that ruin as if he were St. Augustine regarding the City of God.

"A dead city," he whispered almost inaudibly. "The remnant of a mighty civilization, ancient, older than man. That is what I dreamed of finding here on Mars, but I never dared hope." He paused, turned his head slightly toward the huddled group of his assistants; he did not seem to notice the disturbance in their faces. "Take me there. If I die—leave me there, when you go back." He chuckled, an eerie sound through his helmet and the thin air. "The first—permanent—outpost of man on Mars."

They looked at each other, drawing closer together. Dawson, looking years older, jerked his thin shoulders nervously inside his insulator suit.

"We might as well investigate," he said. "We might find something

—anything—to—" His voice trailed off; he could not think of anything that might help them.

Nevertheless, they walked that half-mile across the red sand to the ruined city, leaving one man behind to guard the spaceship—a pointless precaution, since they had no smallest weapon, and there were no signs of life here save for the struggling, drab-green plants—but that city unknown to man had inspired with a nameless fear, with visions of unimaginable beings that might still haunt its ruined towers. Two of the crew lifted Callahan on the stretcher and carried him between them in the midst.

Halfway there, he died.

After a few moments, the two young men took up their burden again, wordlessly, and they tramped on. They crossed highways built of a stuff like cement and like rubber, with a surface of velvet—blasted and torn. They passed buildings that lay in the outskirts, mostly fallen; and at last, when the wreckage-strewn ground had become well-nigh impassable, they came to the canal.

It had cut a swath as straight as an arrow through the heart of the city, and outside the city it angled away to the west across the desert, as far as the eye could see. It was not only a canal, but along its sides had gone passenger walks and many-speed traffic ways, and the great highway had followed the canal into the desert. Along its margins the scrubby vegetation grew in greater profusion, and there were even dwarfish trees.

Now it was choked with debris that had slid and fallen to countless tons from above and around, and here and there it was almost obliterated by a direct hit of whatever terrific weapon had destroyed the city. And the bottom, where otherwise clear, was caked with a layer of fine sand, blown and drifted; that, too, must have been a product of the explosions.

Beyond the canal rose mountainous kitchen-middens, heaps of wreckage so shattered and confused that it was obvious they could go no further. The party halted, and the bearers laid the stretcher on the ground.

"The canals!" exclaimed Dawson all at once, as if to himself. "The canals!"

"There's nothing like that on Mars," said Dave.

Dawson whirled on him. "But we *are* on Mars! We flew a foolproof trajectory, plotted by mathematics. Everything was perfect . . . perfect—" He broke off suddenly, teeth sinking into his lower lip; he was shaking a little.

Dave wondered if in a minute the numbness would leave him and he would be scared, too. He turned away, toward Callahan's bier, and said loudly:

"Dr. Callahan's last wish was to be left somewhere in this city. I suggest we do as he asked, then start worrying about getting out of here—when we find out where here is."

The two men hesitated briefly, then lifted the stretcher. Dave cast

about, and saw not far away, on the brink of the broad canal, a massive block of red Martian sandstone, rough-hewn, placed there long ago for some unguessable purpose. He gestured toward it, and said simply, "There ought to do."

They lifted Callahan to the top of that mighty slab, and laid him there with his face to the burning Martian sky. As Dave started to turn away—feeling curiously his lack of a hat to take off—his foot struck something which gave way brittlely, and he looked down to see a human skeleton.

A naked sunburnt skeleton which must have been a woman's, by the smallness of the bones and the smoothness of the skull. There was a ring on one of the fingers. He stared down at it, feeling no shock for a moment at the token of death in that dead city—then it struck him.

"A human," he said stupidly. "A human skeleton, in a city men never built."

None of them were capable of much more surprise.

"Perhaps men did build this city," said Dawson. He had regained his self-control and was holding it with a great effort. "There must be an explanation—"

It was then that Dave caught sight of the letters cut into one of the weathered faces of the stone block. He stared for an instant, then beckoned to Dawson; the latter stooped, and read the carving aloud.

"Aresia, 2115 A. D."

When Dawson straightened, his was the only face there that was not

as blank as the ancient stone. His was white with a struggle of comprehension and an effort not to believe.

"What does it mean, Dawson?" asked Dave, catching his eye and holding it, unwilling. "What does it mean in mathematics—the name of my home town, and a date over a hundred years in the future?"

"Mathematics could explain it," said Dawson through wooden lips. "But I think I've got the general picture already. It's the fault of the teleport."

"How?"

"When we use the teleport, we travel through a sort of interspace between Mars and Earth, in which the distance is insignificant—infinitesimal, so that for practical purposes we have the planets superimposed. In space, that is. *But not in time.* What we've never realized—they're out of alignment in that fourth dimension, and when you travel from Earth to Mars via teleport, you're going from the Earth of now to the Mars of God knows how many thousand years ago."

"And this—" began Dave and stopped.

"This is the Mars of many thousand years to come, in terms of the teleport. We crossed space in a rocket and arrived only two weeks after we started instead of thousands of years before." He paused, looking down at the heap of bleached bones at their feet. "So this, for us, is Mars of the far future—when the race of man is gone."

The numbness had gone on holding Dave throughout Dawson's explanation; but now something snapped and it vanished. He stared wildly at the technician, crying out: "Gone? Where do you get that? Maybe they're still alive back on Earth."

Dawson shook his head savagely. "They're gone, I tell you. If the race had lived, they'd have come back, because they always come back." He looked as if he were about to cry as he gazed about at the wilderness of wreckage around him. "Perhaps they destroyed themselves, at last. And we—Callahan thought we were the first men on Mars, but we're the last."

Dave thought of Callahan and how, even now, the old man would not have given up. He cried, "We've got to go back—warn them! If men know what's coming, they can plan and avoid it."

Dawson refused to meet his look; his eyes continued to dwell on the ruins. He said softly, "I don't think that we *did* get back."

Then Dave remembered that Callahan had been mad, and that because he had been mad he had led these calm, sane, brilliant young men in the conquest of certain impossibilities of space and matter. And he realized that what they lacked now was another madman to lead them in the conquest of the impossibility of time. He laughed aloud.

He faced them, and shouted:

"We're going back!"

THE END.

Enter the Professor

by E. MAYNE HULL

***Competition** in the Ridge Stars system was savage enough before the Professor and his super-technician mob moved in. That, as a matter of fact, was the item the Professor overlooked—*

Illustrated by Williams

For years, ever since his personal plans had matured, Executive Professor Brian Emerson had waited for an outstanding discovery to be made in one of the many laboratories of which he was head. A discovery that, added to all the others he had stolen from Earth Government Science, would give him the special advantage he felt his purpose needed.

The liquid metal was it.

He did not flinch from the necessities. There were records to destroy, death to mete out to men who knew about the metal, the experimental spaceship, *Creative Physics,* to be secretly readied, and

his own tracks to be covered.

Out in space, heading towards the Ridge Stars, the professor re-examined his situation, and found it good. He had aboard all the liquid metal there was in the universe. And of the seventeen men he had decided would be willing to embark on such a venture, only one had had to be killed.

"Our first task," he said to Hounsley, his chief assistant, when they were five days from their destination, "will be to acquire operating capital. To that end we shall seize the treasure ship, *Tantalus,* which is due to leave for Earth in about two weeks on its next monthly trip.

"The *Tantallus* will be heavily escorted of course. But we shall arrive completely invisible and fire only as many shots as there are ships. There won't be a single survivor."

There wasn't. But afterwards Hounsley came uneasily to the professor.

"Chief," he said, "I didn't know you were going to use liquid metal to dissolve those ships. I didn't even know we had any aboard."

Professor Emerson had an instinct for trouble. "What's wrong?" he said sharply.

"That liquid metal! You know I was one of the first to learn about it."

"Yes, yes?"

"Well, I sold a gallon of it to the science department of the Artur Blord Holding Co."

"WHAT?" said the professor.

Anger reddened his heavy face. His blue eyes glinted with a steely fire. He clenched his hands with a gathering realization of the defeat that threatened here.

The violence of his passion faded before the fact that fury could change nothing. He swallowed hard, then said curiously:

"So you were one of the leaks in EGS. It would be easy of course to get information where you were in Communications."

He forgot that. "Blord, eh?" he mused. "The great Artur Blord, human being extraordinary, the man who never loses, who uses even the mightiest operators of the Ridge Stars for his own purposes. I always intended to stack myself against Blord. Apparently it's going to be sooner than I would have preferred."

He went on, frowning: "Our problem is that we must first establish ourselves in a safe hideout. Nothing is so important as that. Afterwards, if I know anything about Ridge Star psychology, we'll still have time to head Blord off. The big operators handle their own affairs; they don't go to the police."

His dark mood faded. His enormous self-confidence came surging. He laughed a low exultant laugh, and said in a ringing voice:

"Artur Blord, your day is done. At long last you've met a better man."

"Hm-m-m!" said Artur Blord.

He wasn't sure just what he was supposed to do; so he wiggled the glass. The dark-brown liquid in

it swished from side to side like so much water. But no water had ever weighed as heavy as that.

He dipped his finger into it. It felt cool. Room temperature, he judged. He looked up.

"What can it do, Marion?"

He watched while the pretty woman physicist took an eye dropper from her bag, filled it with the liquid—and squeezed one drop onto an ornamental metal paper weight on his desk.

There was a hiss, violent and menacing. The weight began to dissolve. It shook like a jelly, and then ran into a watery pool that covered half the desk.

The woman said: "It will resolidify in about an hour, leaving no trace of the solvent. That drop would have liquefied about a cubic foot of any metal."

"Eh!" said Blord. "Why, that means that a few pounds would dissolve the largest—"

He stopped. His brain spun with memory. "The treasure ship, *Tantalus!*" he gasped.

"I thought," said the woman softly, "the implications would begin to penetrate after a moment. Here's some more: The man we got it from—Professor Hounsley—is one of the group of scientists reported killed in that curious affair on Earth when the experimental spaceship, *Creative Physics,* was stolen recently. Among the more than two dozen dead, all badly damaged and almost unrecognizable, were Ashleyton, the instrument wizard, and—"Brian Emerson!"

"Emerson!" said Blord.

And then he was silent. Brian Emerson, the most famous name in science, the man who for the past ten years had been Executive Professor of EGS.

He had the whole picture now. He said urgently:

"By this time Hounsley will have admitted he sold us the sample. Emerson will strike at me the moment he gets organized in some safe hideout. This is life and death. I've got to find that hideout, and get in the first blow."

He whirled towards the desk eldophone. As his fingers reached for the control, a light glowed, and the plump facial image of Magrusson appeared on the vision plate. The general manager of the Artur Blord Holding Co. Ltd. moaned:

"Boss, Philips has been at it again."

"Don't bother me with that stuff now," Blord said curtly. "I was just going to call you. Listen! Get our secret agents out in force. I want to know if anything unusual has been happening at any of the known criminal hideouts in the Ridge Stars." He explained briefly. "Got that?"

Magrusson seemed not to have heard. "It happened over on Zand III," he said mournfully. "Philips went to the big power operator there, and the deal he made will cost you ten million stellors during the next year if we confirm it."

Blord relaxed slowly. He felt briefly beaten down; and there was a pained expression on his face, as he said:

"Well, you'd better confirm. But

try to negotiate some sense into it. And get that information I want."

He clicked off the eldophone and looked somberly up at the woman.

"Philips?" she said, interested. "Is that the man who—"

"That's the one," nodded Blord, "as if I haven't got enough trouble. I have to confess Philips has me on the run. I don't dare issue a general warning because it might start off a flock of imitators. And the local police commissioner here on Delfi II, an old enemy of mine, has actually had the nerve to tell me that if Philips is found dead, he'd have me up in court. Even if the police were friendly, it would be hard to prove anything against the fellow. He's a cunning chap who's beaten a dozen murder-theft raps. He's trying to blackmail me for five million a year."

"If I were you," said the woman after a pause, "I'd concentrate on Emerson. Frankly, chief, I'm scared. These men are SCIENTISTS in capital letters." She hesitated. "I know this is heresy, but why not go to the space patrol?"

There must have been a look on his face, for the woman said hastily:

"All right, all right, I know Ridge Star operators don't go to the police with their problems. I'm sorry I mentioned anything so reasonable."

Blord said tonelessly: "You're quite wrong about it being reasonable. All the police forces are riddled with spies."

"But," she urged, "publicity is what you need in this case. The moment you reveal the existence of the liquid metal and Emerson's identity, he has no more reason for coming after you."

Blord laughed grimly: "And then suppose I'm called up before a lie detector, and asked to explain where I got my sample of liquid metal. In case you don't know it, bribery is a criminal offense even in the Ridge Stars. No, my dear, we have two advantages over Emerson. First, we're the only ones who know his identity. Second, he can't be sure that we know.

"We mustn't give up either advantage lightly."

"Well," said the woman, "don't count on your own physics lab matching science with wizards like Emerson, Ashleyton, Hounsley *et al.* This has got to be one of your clever tricks."

She took the glass and its contents, and went out.

It was two hours later that the call came through from Magrusson. "The city of Hid on the cave planet?" said Blord. "Good work. . . . I'll keep in touch with you."

A shadow moved from a cave of Carnot. It flitted over a pile of rubble, then crouched behind a rock and looked down at the cave city of Hid.

The city sprawled over a porous plain, its towers reaching up towards the high, overhanging ceiling of rock. There were blaze points of atomic energy in that massive ceiling, and a very fire of light shed down on the city below.

The shadow shimmered as it came out from behind the rock into the atomic light of Hid. Swiftly, now, as it moved forward, it dissolved into the unchanging artificial brightness of the underground city.

Once in the city, the invisible man lost his haste. He walked a score of streets, crossing roads to avoid the shadows of buildings, and carefully stepping aside for men and women hurrying along the sidewalks.

He paused for minutes on end, listening to conversations; and, for half an hour, he stood staring up at the great central administration building, above which a spaceship floated. At last he made his way to a large showy building with several entrances. Glitter signs flared colorfully:

CHEZ MADAME
GAMES AND GIRLS

The invisible man glided lightly through one of the entrances, through an oddly empty gambling salon, and along a brilliant corridor. There was a key in a clever little contrivance beside one of the doors. The door opened into an imposing apartment.

In a leisurely fashion, he went to one of the bedrooms, and took off the invisibility suit. He had just lain down on the bed, and lighted a cigarette when the key clicked again in the outer lock.

A woman's voice said: "Oohh!" Footsteps sounded; the bedroom door was pushed open, and a buxom, motherly looking fifty-year-old woman came rushing in.

"Artur," she said. "Artur, it's you! Or rather the flesh mask version of you that you let me see."

Artur Blord smiled. "Well, Kate," he said, "I'm glad you're so glad to see me."

"Artur," she said heavily. "You're not kidding. Glad is a tiny word for the way I feel. Crime doesn't pay any more, at least not in Hid. A month ago, this city was taken over by a bunch of scholarly looking men. And I mean taken over. They killed the seven big shots of Hid, including tough guy Boss Tanser himself, and took over the administration building. They just laughed at our defenses, and our weapons, which were designed to hold off any attack the space patrol might care to make—if it ever discovered there was an underground city here."

She sighed wearily. "Artur, I'd like you to get me out of here.

They've lengthened the working hours to twelve a day. They've got the factories running on shifts, and all the fancy criminals who were hiding out here are in them, chained to machines, turning out good work or else. My business is all shot to pieces."

Artur Blord was frowning. "What are they manufacturing?"

"Instruments!"

"What kind?"

"I only know about the ones in my joint. Just imagine, my own place put into a mechanical strait jacket. The devices are just inside the doors and windows, and they look me and my customers over when we come in or go out."

"Look you over?" Sharply.

"They've some kind of an X-ray machine. They compare the shape of my bones and my insides with a previous record inside the machine. They make sure I'm me—What's the matter?"

Blord was on his feet, struggling to pull his invisibility suit from under the bed, where he had put it. The woman stared at him, startled. Abruptly, alarm came into her thick, jolly face.

"Oh, space!" she muttered. "One of those seeing-eye things must have registered *you* when you came in. It—"

There was a heavy pounding on the corridor door. Blord shrugged, pushed the invisibility suit under the bed again, and accepted the handcuffs a few minutes later without resistance.

He was taken straight to the administrative center.

As he was led into an elevator, Blord was thinking tensely: The important thing was to keep his identity concealed behind his flesh mask. And remember that *they* couldn't have time to check personally every individual of a city of half a million population.

Fortunately, he had taken a few mental precautions before leaving his ship.

His thoughts slowed, as the elevator stopped. He was led along plush-floored corridors to a door marked:

CITY DIRECTORY

Inside was a large office with several hundred girl clerks at various machines and, to one side, a long series of booths. A young woman came forward, then motioned Blord's escort to lead him to one of the booths, where another young woman, a blonde, sat behind a desk. The first woman went away.

"Have you searched him?" asked the blonde briskly.

The job was done then and there. It was thorough but only in a surfacy kind of a way. It removed his shoulder gun, his sleeve blaster, and his three electronically treated knives. It took his pocketbook, the extra money in the lining of his coat, and his shoes with their hollowed soles and heels.

It failed to test his teeth, or the buttons on his coat, nor did it locate the variety of transparent drugs under his fingernails and toenails. When it was finished, he

was motioned into a chair opposite the blonde; and the interview began.

His name? He gave that as Len Christopher. His occupation? None!

"Nothing at all?" Sharply.

"Oh, I just sort of move around," said Blord in his most transparent, evasive manner.

She wrote down: "Thief."

It struck Blord that it was time he made a protest. "Say, listen," he began in his best underworld lingo. "What goes on around here. I come to Hid in my usual manner, and what do I find—an organized city."

The girl smiled grimly. "There have been a few changes. By what route did you come here?"

"I ain't sayin'," said Blord.

Out of the corner of his eyes, he saw the fist of one of his escort smashing towards him. He took the blow moving away, and so it merely stunned him. But he lay back as if he had been knocked out, and let them pour water on him to revive him. He shook his head dizzily. The woman said coolly:

"We like answers to our questions."

Blord said sullenly: "A friend o' mine put me down in one of the caves that comes into Hid at the north. Took me about two hours to walk in."

Actually, he had come in from the south. But he was a badly worried man. He thought in dismay: "What have I run into?"

The young woman said: "Take him over to the map."

It was an ordinary three-dimensional map of the caves; and Blord knew them all well. Their outlets in the barren surface of the planet and most of their capillary offshoots and dead ends had long ago been hypnotically impressed upon his brain.

Looking at them, Blord hesitated. It was not impossible that some of the entrances had had "seeing" instruments concealed in them. It made the problem of lying difficult.

"They look," he temporized, "kind of funny, seen like this."

"Which one?" said the cold-voiced young woman.

Blord decided on the truth. The important thing was that he mustn't be brought before Emerson or Ashleyton or the others. No other danger could be as great as the thorough examination such men would give him.

The cave by which he had entered couldn't have an all-coverage "seeing" device in it as yet, because he hadn't been arrested until he crossed the threshold of the Chez Madame.

After he had indicated the southern cave by which he had entered, the young woman said:

"All this of course will be verified by the lie detector."

"Whaddaya think I'm telling the truth for?" said Blord. "I can recognize a solid set-up when I'm in it."

He was feeling easier now. His conviction that individual cases *must* be left to subordinates had proved correct. As for lie detectors, that at least he had prepared for. He was doped to the hilt by mechanical hypnosis.

"And now," said the woman, "where have you been staying since you arrived?"

"Oh, I just got here today," said Blord. And realized from the look on her face that he had blundered.

"Today?" said the young woman in surprise. "Why, that's impossible. No one has come from outside for eight days without setting off the alarms."

She twisted to look up at the men. "Take this fellow," she commanded, "to see the chief of directory. I think he's lying, but orders are to have all doubtful cases checked by number three of the heirarchy."

Five minutes later, Blord was standing stiffly in front of the famous Professor Ashleyton. Before the scientist had time to say anything, a door opened, and Brian Emerson walked in.

The arrival of the great man was pure accident, Blord was convinced. But the coincidence chilled him. In all his career, chance had seldom worked so hard and so often against him.

Emerson walked over behind Ashleyton, and glanced down at Blord's "Len Christopher" record, which Ashleyton was reading. The

action gave Blord time to examine the two scientists.

Both were wearing flesh masks. But Blord had studied their three-dimensional motion picture images until he could recognize the very way in which they stood or sat, the slight stoop of Ashleyton's shoulders, the deep chest of Emerson. Ashleyton was tall and thin, with bony fingers and an elongated head. Emerson was tall and big, his face square and massive. The man radiated physical and nervous strength.

Looking at him and Ashleyton, at the flesh and blood reality of them, Blord felt a morbid thrill. Suddenly, the situation he was in seemed fantastic. It was one thing to sit in his office, and analyze the presence of these men here in the Ridge Stars from the scanty data he had had. It was another, oh, quite another, to see them in the environment of Hid, men who had a short time before been honored and responsible citizens—to see them now acting their chosen roles of super-pirates.

The heady thought shattered, as Emerson laughed, a thick, guttural, confident, good-humored laugh.

"It would be interesting to know, Christopher, which of the three possible methods you used in getting by our temporary alarm system. Was it an invisibility suit or—"

He stopped. "Never mind. By the time you get back here, the coverage will be complete with some interesting gadgets."

He shrugged. "You're a lucky man, fella. Under normal conditions, you would already be working at a machine in one of the factories of Hid. But instead we're going to send you to Delfi II."

"Huh!" said Blord. "What for?"

It was not bad acting, he thought. Emerson was speaking again:

"Have you ever heard of Artur Blord?"

"Have I ever heard of—" Blord echoed; and then he laughed. It was a derisive laugh, the very best one he had ever done. "Listen, Boss," he said finally, "you're not going after Artur Blord. Why, you'll eat dirt so fast, you'll never know what hit you."

Emerson made no immediate reply. The smile had faded from his face, but there was a faint, superbly confident contempt in his expression. Looking at him, Blord felt a sudden chill, a consciousness of what a man was here. Emerson said at last in a flat, unemotional voice:

"Artur Blord will be dead in two weeks. His death is necessary because he knows, or is on the point of knowing, something about me. I'm sure that *if* he knows, he hasn't had the knowledge for long. Information percolates slowly through these big organizations, and only a few individuals ever learn any particular fact. Every such individual must die."

The monotone ended. "The Ridge Stars," Emerson said in a strange, proud voice, "are going to discover that *somebody* has arrived, a force to be reckoned with and

kowtowed to. For instance, my plan against Blord includes the taking over of his entire organization."

He broke off curtly: "But enough of this. Your instructions, Christopher, will be given you when you leave. And now—hand me that syringe, Ashleyton."

One look at the yellowish substance in the transparent tube of the syringe, and Blord knew the worst. It had been clear for minutes that Emerson's presence in Ashleyton's office was NOT an accident. The blonde in City Directory must have advised Ashleyton that somebody was being sent up; and Ashleyton in turn had called Emerson for *this* purpose.

Unobtrusively as possible, Blord started his left hand up towards his mouth. If he could swallow the drug under his middle fingernail—

To cover his intention, he said nervously: "What're you going to do to me, Boss?"

Emerson laughed again. "This is what is known as seven-day poison. In its primitive state, it reacts chemically with the blood, and kills on the seventh day. Actually, to those who understand the complex protein structure of the poison, the time lapse between injection and

death can be varied at will. This particular mixture, for instance, is set to kill on the thirtieth day.

"There are only two antidotes. One of them must have the original poison mixture as a base, and can be administered any time up to the moment of death." Emerson smiled. "Since we are keeping that mixture here, you will readily see the importance of carrying out your instructions to the letter. To save your life you will have to return to Hid for the antidote."

He paused. He seemed to be in the grip of some secret amusement. Then:

"The second antidote has to be taken in advance. Clever men frequently carry a dose under their fingernails and— *Grab his arm!*"

The professor laughed with a throaty triumph. "No, no, my friend. Tricks like that don't work with us. Roll up his sleeve!"

The needle was a brief pain in Blord's arm.

"That's all," said Emerson. "Take him to 'Transportation.'"

After an hour, the council of war in Blord's office had gotten nowhere. Blord studied the faces of the man and the four women. For the first time in his life after an adventure, he had a curious feeling about these people who worked for him. He felt remote, aloof, dissociated.

The world was full of a number of things; and in thirty days less the five days it had taken him to get back to Delfi II, he would not be one of those things.

The poison made a difference in outlook. He studied the faces, and was sharply aware that they were mostly women. Funny that men who came to the Ridge Stars could never be completely trusted in a subordinate position.

Phyllis Riddell, who had been his secretary now for eight months, was saying with a quiet confidence:

"I'm sure Mr. Blord will think of something."

Blord mustered a wry smile for her. But all he said was:

"Not once after I was captured did I have a real chance of doing anything on my own, and my final release had nothing to do with any personal skill. Nor, considering the poison, was it actually final. Whatever plan we work out must include my return to Hid to a *living* Emerson and Ashleyton, to get the antidote injection."

There was silence. The three other women in the room, all scientists, looked at each other. One of them said at last with a sigh:

"Your predicament greatly limits any planning we might do." She added: "You haven't told us yet what instructions Emerson gave you as Len Christopher. We might lay a trap."

Blord smiled wearily. The suggestion was typical of what this meeting had so far produced: vague, ordinary, unimaginative, almost defeatist. He said:

"Here's the catch to that, Sarah. At eleven o'clock on March 28th—that's nine days from now—I'm supposed to beam my information on an individual sender, which they

supplied me. Try and lay a trap with that set-up."

"But what information do they want?"

Sharply, urgently, Marion Clark, the chief of his science staff, who had first brought him the liquid metal, asked the question.

"I'm supposed to learn something about the movements of Artur Blord," said Blord, "and Hounsley, their communications man."

Magrusson, the only other man in the room, wiped the sweat off his heavy face.

"I hope to space," he said, "they don't get the idea of blasting this building."

Blord smiled at the general manager. The other's gloom made him suddenly more cheerful.

"Don't worry about your skin, Fatty. You're safe. Emerson has spectacular ideas, and one of them is to take over all my property. He'll need you to manage them."

"But—" said Magrusson wildly.

"Don't ask me," said Blord, "how he's going to work it. That's what's worrying me. If he can take over my estate, then the galactic legal system is worthless. Let's suppose I get killed.

"Of course," Blord went on, "everybody in this room is in my will. And some eight dozen families scattered throughout the Ridge Stars, as well as some others, altogether about a thousand people."

He smiled. "The split-up isn't as bad as it sounds. I'm sure," he went on, "Magrusson himself has no clear idea of my total wealth. I own whole cities. On some planets every factory, every power plant, every mine belongs to me. Years ago, my fortune grew so vast and unwieldy that I realized control was impossible, so I adopted a policy of letting other men own and operate, while I accepted twenty-five percent of the profits."

He broke off: "My will is registered on the Registered Circuit, supposedly a foolproof mechanical device, so much so that every deal great or small, on Earth and elsewhere, is dependent upon its inviolability."

His face darkened. "I am going to assume that not even Ashleyton can alter anything already registered on the Circuit. However, he might be able to add something. What?"

There was no real answer. Magrusson moaned softly: "Everything has been going wrong lately. First, that scoundrel, Philips, pulls his stuff again and again and—"

Blord interrupted him: "I see," he said bleakly, "that we'll have to think this business over."

The meeting broke up in a dead silence.

On the third day after the meeting, Blord was at the main physics laboratory:

"This liquid metal?" he asked Marion Clark. "How does it work?"

The woman physicist said: "In one sense it was an inevitable development. From the beginning of science, man has refused to accept the shapes and forms that Nature evolved. Why should metal

be a solid? It is merely an atomic, electronic, megonic structure reinforced by graviton tensions.

"In liquid metal, these tensions are relaxed by the removal of the gravitons. The metal flows in a molecular stream but—and this is what makes the process important—it greedily absorbs gravitons from the nearest layer, thus setting off a chain of liquefying reactions. But some of the gravitons are radiated in the form of gravitic energy—that hissing sound you heard—and therefore it takes about an hour before a newly liquefied piece of metal returns to its solid state."

She broke off eagerly: "Have you got an idea about the metal—against Emerson?"

Blord shook his head wryly. "I haven't had a single thought," he confessed.

Two days later, Blord was back at the laboratory.

"I'm puzzled," he began. "Suppose Emerson came up to my office to kill me, and as the door opened he was met by every conceivable type of weapon fire. Mind you, that won't happen. I can't afford to have him killed until I have the poison antidote. But he doesn't know that, and therefore will expect that I have a defensive system. Is there anything known in science that would help him?"

The woman physicist looked at him steadily. "Not *known*," she said at last. "But about seven years ago, a rumor started on Earth to the effect that an EGS scientist had developed a basic counterant to all radiant guns. Rumor had it that the counterant reversed the flow of power, which invariably resulted in the destruction of the gun and, of course, its wielder. We put all our spies in EGS, including Hounsley, on the job, but all they could report was that several important scientists had died suddenly. The rumor remained just that."

For a long time after she was finished, Blord was silent. His mind came back from its remote speculations, and he was aware of his brain, much as if it was a separate entity, considering his answer.

"You know," he said at last, slowly, "I can see now that you were right. I've been approaching this whole problem from the wrong angle. You warned me, remember, not to count on our science to

match that of Emerson and Ashleyton. And there's no question of it. For ten years, he's had the pick of the inventions of more than ninety thousand EGS scientists. On his own ground he's undefeatable."

"You mean you've got an idea?" Eagerly.

Frowning, Blord shook his head. "I'll have to think it over. My materials are men and their psychology; my methods are tricks. I should have thought of that before. There must be something—"

The sixth and seventh days he had no ideas. On the eighth day Blord sat in his office thinking in a shocked wonder: Was it possible that he was really beaten?

The thought ended as Magrusson came in. The plump man's face was longer than usual.

"I've got a carload of trouble for you," he began darkly. "How would you like it—in pieces or all in one lump?"

Blord laughed. He couldn't help it. The man was too gloomy. To Magrusson, life was so serious a business that it took all his energy to keep from sinking into a state of permanent depression.

The general manager snarled: "You're a fine one. Tomorrow we may all be dead, and you think it's funny."

With an effort, Blord ended his burst of amusement. He sat back in his chair, more relaxed than he had felt in many days.

"Thanks," he managed at last. "I needed that. Go ahead and tell me anything you want. It may distract my mind, and give me an idea."

"First," said Magrusson bleakly. "There's Philips. His latest—"

"Philips!" said Blord. The tingle that stabbed through his body warmed his brain. "Philips!" he repeated loudly. "Why, of course. He's the answer. How could I have forgotten Philips?"

He was on his feet now, the life surging along his nerves and muscles, the sparkle back in his gray eyes, his whole body alive with excitement.

"Magrusson," he cried in an intense voice. "Get me Philips up here. Tell him, we'll agree to his blackmail. Tell him anything. But get him here!"

The general manager stared at him gloomily. "You must be crazy," he said. "Have you forgotten that you've still got to go to Hid. What makes you think Emerson will even bother to give you the antidote?"

"He'll give it to me," said Artur Blord savagely, "in order to save his life."

"It sounds dangerous to me."

"Of course it's dangerous!" snapped Blord. "It's danger that makes life interesting." He broke off. "What a fool I've been. The psychology of this business has been plain from the beginning: Hounsley—Philips!"

"The real danger," said Magrusson with sudden insight, "and the main trouble with you, is that you admire men like Emerson. I'll bet you're going to let him live."

Blord scarcely heard. He was

laughing harshly: "The Philips part is going to be pretty sordid, but he's been asking for it."

Artur Blord was dead. Accidentally killed by the explosion of his own electron blaster. According to the police, he must have taken it out of his holster for some idle purpose, and it short-circuited.

On Delfi II, the news spread with all the violence of a radian shock. Crowds gathered at the foot of the two-hundred-story Blord Building, and stared curiously up at the remote penthouse where the accident had happened.

The news flashed by eldophone through the Ridge Stars, and reached on to Earth, and to the remoter stars beyond. His fame was surprising. Everywhere public eldoplates and newspapers carried the picture of his dead body, almost torn in two, and lying in a great pool of vividly red blood at the foot of his desk.

It was not a good picture, aside from its horror. It showed his face too clearly. And there was a half snarl on that distinctive English face that suggested that, at the instant of death, an unpleasant and hitherto concealed characteristic of the famous operator had stamped its soulless imprint on his countenance.

A strange wolfish Blord lay dead in that palatial private office. The eidolon shocked millions of his admirers, and several newspapers commented editorially on the fact.

Most papers and commentators, however, were generous with their praise. His fantastic exploits were written up in detail. And the papers quoted with genuine pleasure the statement of General Manager Magrusson that: "I didn't even know he was in his office. I thought he was somewhere out at the other end of the Ridge Stars. But that's the way he was. He came and went like a ghost."

To the end, the newspapers pointed out, he had lived his strange, dramatic life to the full.

On the fifth day, interest switched to a new angle of the case: The Blord fortune! Newspapers were expansive in their estimates of its extent. A trillion stellors was the smallest figure printed; and, as the tidal wave of estimates grew, the question began to be asked: who were the heirs?

On the seventh day, the director-general of the Registered Circuit arrived from Fasser IV, and issued a cautious statement to the effect that there were two wills, one made only a week before Blord's death, which completely superseded the earlier one.

It was a perfectly legal will, and it left the entire Blord fortune to one, Johann Smith, who was staying at the Blord Hotel. Upon this hotel, reporters descended *en masse*.

They were granted an interview by a man of magnetic personality who bore a suspicious physical, though not facial, resemblance to Professor Brian Emerson—but no one noticed that—and who issued a statement to the effect that: "I once saved Artur Blord's life. I am leaving the case in the hands of my

lawyers and the courts. I'll come back when the legal situation is straightened out."

The next day he was not to be found.

There were ways, Artur Blord knew, of getting into Hid that no group of professors, newly arrived from Earth, could possibly have discovered. These entrances—and exits—were not dangerous to Hid in its role as a hiding place. But for simple purposes, such as the movements of careful individuals, they served very well indeed.

They had been built by the former Boss Tanser of Hid for emergency use; and Blord's co-ordination department had paid he forgot what sum to a Tanser henchman for the secret.

Blord arrived invisible, mainly because there were certain things he had to do.

Having done them, he walked wonderingly along the streets of a transformed Hid. The city's boulevards were crowded with sleekly dressed men and women. The gaming houses swarmed with players; and, as doors opened and shut, the streets echoed with laughter and clinking glasses, the sound of whirring wheels and the calls of the croupiers. Blord had brief glimpses of flashing interior lights, and a sustained view of miles of dazzling street signs.

Here was the old Hid, with something added. The playhouse hideout of a hundred thousand wanted criminals, waiting for the police to forget.

A score of conversations listened to, gave Blord the picture: The feverish factory work into which everybody had been forced, was over. The frightened crooks, discovering that their labor had been designed for the sole purpose of strengthening the defenses of Hid, had felt so relieved that their reaction was admiration for the new city bosses.

The talk along the boulevards was that, in future, Hid would be the base for gigantic operations. There was an over-all excitement that infected individuals. They shouted oftener, they laughed louder and they gambled more recklessly.

Everywhere was a sense of great doings in the offing.

After an hour Blord had no doubt that they were right. The Ridge Stars were about to experience an era of unequalled crime.

Grim with the potentialities, he departed at last the way he had come—and a few hours later entered Hid by the more regular route he had used a few weeks before.

As he emerged, a force struck him, pinioned his arms, lifted him into the air, and catapulted him at express speed along a gravitic line. The speed lessened after a few seconds, and he could see his destination: a car, one of several, on a track.

He was dropped into it lightly. Instantly, still without human intervention, the car raced off across a barren field towards the city. During the entire trip, his hands and feet were held by energy vises. Abruptly, the car rushed into a tunnel, and came to a stop inside a steel cage.

Lounging men sprang towards the car, released him from his bondage, and took him up to City Directory. It was a different girl and a different booth this time, but Blord did not wait for the interview. He said coolly:

"You may tell, er, Number One of the Heirarchy that Artur Blord would like to see him."

That brought results.

They were waiting for him, a dozen men, standing in small groups, talking in low tones. They turned as he entered, handcuffed, his four guards alertly surrounding him. Emerson came forward, frowning. He waved the guards out of the room. Then:

"If you're really Blord, I must say I admire your nerve but not your intelligence."

Blord smiled wanly: "I'm afraid, Emerson, you'll have to admire that too, before I'm finished."

"Emerson!" exclaimed Emerson.

There was a stirring in the background. "Space!" said a man. "He knows us."

A profound silence settled. The former EGS professors, with the exception of Emerson, stood tense, eyes narrowed, their minds obviously racing over the possibilities of the identification. Emerson alone seemed strengthened by the revelation. He smiled a sardonic smile; then he laughed a throaty, chuckling laugh.

"This is a good one," he said. "So we caught Artur Blord in our trap a few weeks ago, and didn't know it."

His laughter ended on a curt note. "You silly fool," he said coldly. "You could have got away without a suspicion on our part. I fully intended to give you the antidote."

"I believe that," said Blord, "which is why I'm going to let you remain alive."

The words had a chilling effect. Emerson drew back, his whole body stiffening.

"I'm not sure," he said slowly, "that I'm amused any more. Who was that chap in your office who drew his gun on Ashleyton and my-

self when we went there to kill you?"

"Do you mind if I sit down?" Blord asked. He did not wait for an answer, but walked over to the nearest chair. The moment he was seated, he held up his manacled hands. "And how about taking these off? They're quite unnecessary."

No one moved. "Come, come," said Blord sharply. "I've been thoroughly searched. My clothes have been changed, my fingernails and toenails scraped, my two false teeth removed. My victory over you has nothing to do with any action that I personally can take against you. I expect intelligent understanding of such details."

There was a pause. Then Emerson called the guards. "Release him," he said grimly.

When the guards had gone, Emerson said: "Start talking. First, that fellow in your office?"

"Philips was his name," said Blord without hesitation. "He's been going around the Ridge Stars imitating me physically, his purpose being blackmail. I thought I'd let him find out that being Artur Blord wasn't all gravy; and you didn't give him a chance to talk, so—"

He ended quietly: "I saw the death scene in a film that was taken of the whole affair. Very interesting."

Emerson was cold now, cold and deadly. "It is indeed interesting," he said from between clenched teeth. "I suppose you realize that you are completely at our mercy, and that we will get every scrap of information in your brain. Particularly we will find out who else knows how much, what precautions you have taken, and every other related item."

Blord was shaking his head, smiling. "It isn't as simple as that, I'm afraid. You see," he went on, "I have a basic advantage over you which those of you who have just kicked over the traces of respectability, cannot properly appreciate:

"I have no fear of death. That sounds odd, I know. People have the idea that because I own a quarter of the Ridge Stars—that's an exaggeration—I have everything to live for. They're wrong. I've *had* everything that life has to offer. To me the only moments that matter are moments like this, and even they are beginning to pall."

Emerson said steadily: "We have yet to hear a single word of concrete evidence from you."

Blord ignored the interruption. But his smile had thinned; he leaned forward tensely. He said smoothly:

"All this is preamble to the following statement: It is easy for a man who does not fear death and who has unlimited money to deal in bribery, corruption and the fear of death in others. I am thinking particularly of your colleague, Professor Hounsley, who used to take bribes from me, and who is NOT, please notice, in this room. Nor will a call to where you think he is, do any good."

It would have been hard, Blord reflected after he had spoken the

words, for Hounsley to be anywhere in a coherent fashion. Dead men didn't turn up at gatherings.

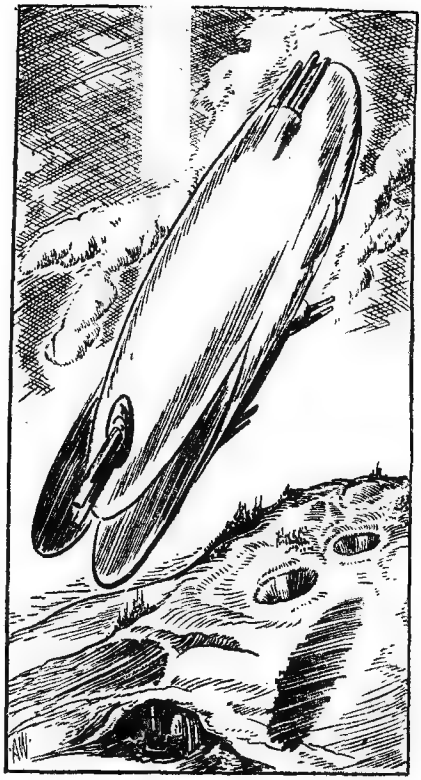
A week later, Blord felt the difference in the atmosphere of his office. This time the four women were all smiles. Even Magrusson's moon face was a shade less gloomy.

"It was all really quite simple," Blord said immodestly. "I had to die realistically to find out if Emerson really could get around the Registered Circuit, which is the very basis of our contract and legal system. It turned out that all he could do was insert a skillfully forged will."

He went on, after a pause: "While Ashleyton and Emerson were in my office killing Philips, I called Hounsley on the sender Emerson had given me. I offered him one hundred million stellors to let me see the secrets aboard the experimental ship, *Creative Physics.* Figures like that always stagger the minds of men, and it is amusing to make such offers even when you have no intention of paying.

"Hounsley was shocked when he discovered I was still alive; and I knew I had him when Emerson came to Delfi II under the name of Johann Smith to claim my property. It was obvious that Hounsley had failed to report my conversation with him.

"Perhaps he intended to betray me. I don't know. I arrived in Hid on the day it was his turn to look after the *Creative Physics,* and killed him the moment he let me aboard."



Blord stopped at that point, and looked questioningly at Magrusson.

"What's the matter?"

The plump man said: "How is it that Hounsley wasn't wearing one of those devices that explode all firearms in reverse?"

"Oh, he was wearing one all right," Blord said. "I choked him to death, so I wasn't really interested in his other defenses. Physically, he was picayune."

"Oh!" said Magrusson.

Blord went on: "As soon as I was in control, I let Marion and

Sarah aboard—and the rest was simply a matter of letting Emerson know that there was a ship floating above that was ready to level the whole city of Hid. I gave them my usual line about not being afraid to die. They knew *they* were, so—"

He laughed with a wild glee.

Physicist Marion Clark was shaking her head. "I can't understand why you let Emerson and the others remain alive."

"Eh!" Blord stared at her. "Darling," he said, "I couldn't take a chance on Hounsley being alive when you two were alone on the ship. But if I started to kill all the men in the Ridge Stars who needed it, I'd have to build a gun as big as Earth's moon, and blow up every planet in the Ridge Stars.

"Besides," he went on, "the professor, now that he has been shorn of his main secrets, should prove a colorful addition to my file on big operators of the Ridge Stars."

He finished thoughtfully: "Emerson of course is a melagomaniac. Sooner or later, he'll come after me again; and I may have to kill him. Whatever happens, I shall be ready."

THE END.

THE ANALYTICAL LABORATORY

The results on the October issue again indicate a two-division grouping of the stories. The scores read:

Place	Story	Author	Points
1.	Renaissance	Raymond F. Jones	2.27
2.	Beam Pirate	George O. Smith	2.68
3.	Blind Man's Buff	Malcolm Jameson	2.72
4.	Kindness	Lester del Rey	3.31
5.	The Wedge	Isaac Asimov	4.33

Two groupings—the first three stories were almost tied—appear. The two groupings coincide with the long-story and short-story divisioning, too. In science-fiction, the long story has a very real advantage over the short, in that so much of story effect is based on the background against which the yarn is laid. On the other hand, the hard knocks "The Wedge" received, despite the fact that, as one of the Foundation series it had the carefully developed background of a longer story, seem to have been due to one thing: this particular Foundation story was a minor, almost unimportant, incident in a major series.

THE EDITOR

Nomad

by WESLEY LONG

***Part** Two of Three parts. Kidnapea by and nearly killed by Martians, taken and restored by Ertene—and driven from that planet, Guy Maynard was yet to find that Earth, too, could turn against him. And he against all three.*

Illustrated by Orban

Synopsis

Guy Maynard is kidnaped by Martians who intend to extract secret information. His capture is seen, and in a running fight in space, the Martian spaceship is seriously damaged. Maynard, however, still lives but is also in a damaged condition.

Thomakein, a vanguard observer from Ertene, watches the space encounter and decides to inspect the derelict. He finds Maynard and takes the Terran back to Ertene because he knows that the Terran will be a valuable source of information as to the society of Solar System and its science.

Maynard is nursed to health by Charalas, a brilliant neuro-surgeon, who acts for Thomakein when the

Ertinian returns to his studies of Sol's planets. Maynard is taught Ertinian lore, and learns that Ertene is a wanderer, concealed by a "light-shield" and is seeking a suitable sun to use as permanent primary.

But Ertene has enjoyed several thousand years of wandering, and her scheme of life is geared to itineracy. While theoretically gathering information that will tend to decide for or against joining the Solar System, Ertene is really against such an alliance. Maynard is educated in all phases of Ertinian culture in order that he may be able to draw parallels to the Ertinians as a measure of desirability.

After a year on Ertene, he is given his chance, and since Ertene prefers to be a nomad, Guy fails to convince the Ertinians that they should join Sol. After he fails, he asks what they intend to do with him.

Ertene tells Guy that they have no intention of killing him, nor may he remain on the planet. He is sworn to secrecy about Ertene and inoculated with an Ertinian drug that compels his conscious mind to keep secret any facts that his subconscious mind desires kept.

Painstaking evidence is prepared, including a year's log of his "wandering" in a damaged lifeship from the derelict. This evidence includes several theories on instruments and effects that Maynard is supposed to have developed during the solid year of solitude in the lifeship. These developments are the instruments used on Ertene whose science is slightly superior due to the fact that the wandering planet has had the opportunity of studying many worlds in her travels.

Maynard's return by space is intercepted, and when he lands in the Terran Space Patrol ship, the executive officer destroys the lifeship to conceal the evidence of the year-old space-fight against the Martians. Maynard is welcomed back, though he is under the eye of the Court of Investigation until cleared.

The court, urged by Thomas Kane, a publisher and friend of high officials, accepts Maynard's story and the log of his travel, which he took to the Patrol ship before his lifeship was destroyed. Kane makes further recommendations, that Maynard be raised in rank, and that he be given a chance to develop some of the ideas he has had on his "trip." Furthermore, he suggests that the "trip" be suppressed, and that the log be destroyed so that absolutely no evidence of the Terro-Martian space-battle remains. They are to transliterate the log into a laboratory notebook and give Maynard publicity for having succeeded in making scientific developments in a secret laboratory under official orders.

Maynard, somewhat amused that all of Ertene's carefully fabricated evidence is destroyed due to Terra's fear of Martian suspicion, leaves the Court of Investigation a free and lauded junior officer. He is filled with a determination to get Ertene's science into play so that Terra will have dominance over the Solar System. Though Ertene plans

to pass on, far from the inner planets, the effect of the nomad's knowledge will bring forth changes in Sol's history.

Guy Maynard paused a moment before he pressed the doorbell. He'd been missing a long time, and he wondered just how Laura Greggor would greet him. He hoped her eagerness would match his, at least, and with that prayer he rang.

Laura came to the door herself, which lifted Guy's heart. She took him by the hand and drew him in, saying: "Teemens is busy mixing a cocktail. I had to answer myself."

Guy wanted to say "Oh" but didn't. He knew that the tone of his voice would have betrayed his feelings. And then he lifted his feelings again by main force. After all, Laura was no schoolgirl. There was no reason why she should be carried away by any cheap melodrama. She believed him to be an M-12 and as such he was doing a job. He wished he could tell her the truth; perhaps then she would be more emotional in her greeting.

So after a solid year of semi-loneliness, Guy was greeted with a carefree: "You've been gone a long time, Guy. I'm glad to see you."

"I'm more than just glad to see you," said Guy earnestly. He gave her hand an affectionate squeeze and then tried a gentle urge towards him. It was almost unnoticeable, that attempt to draw her to him; and had he not met with instant and opposite reaction—

He sighed, relinquished her hand, and then handed her the small box he held under the other arm.

Laura looked at the corsage and then said: "Wait a moment, Guy. I want to run in and put this in my hair. Make yourself comfortable."

Guy entered the large drawing room and looked around slightly in wonder. It was the same—but he hadn't remembered it as being so large. Everything was as immaculate as ever and Guy felt slightly out of place there. He knew that he was expected to sit down, but that old feeling of wondering which piece to sit upon came back to him.

He found a chair that had a minute scratch on one leg and seated himself. He wanted a cigarette, but there was no ash tray nearby and so he stifled the want. He was seated in the chair stiffly when Laura returned with the gardenia in her hair. She was smoking a cigarette and as she passed through the room she flicked the ash negligently at a large ash tray. Some of the ash missed and landed on the deep carpet. Laura didn't notice.

"My," she said. "You look slightly formal, Guy."

"Relax, Guy," her mother told him as she entered just behind Laura. "Andrew was telling me of a few of your ideas. Too bad you can't tell us more. We're interested."

"I'd like to tell you, Mrs. Greggor," said Guy shyly. "But I'm under strict orders not to disclose—"

"Pooh, orders," said Laura. "Oh well, you can have your silly secrets.

I want to know, Guy; did you miss me?"

"Quite a bit," he answered, thinking that this was no time to ask a question like that. Her mother's presence took the fine edge off of his anticipated answer.

"I'd like to go out in a Patrol ship," said Laura. "This normal traveling on the beaten path doesn't seem like much fun to me."

"It's no different," said Guy. "It's the same sky, the same sun, and the same planets. They remain the same no matter what you're doing."

"Yes, but they're in different places—I mean that you aren't always going Venusward or Terraward. You change around."

"It's still similar."

"Don't be superior," Laura said. "You're just saying that because you're used to traveling in a Patrol ship."

"No," said Guy earnestly. "It is still the same sky whether you look at it from a destroyer or a luxury liner."

"Some day I shall see for myself," said Laura definitely.

A faint, male roar called Mrs. Greggor's attention to the fact that her husband had mislaid his shirt studs. "I shall have to leave," she said. "Please pardon me—?"

"Certainly," responded Guy, jumping to his feet.

She smiled at him and left immediately.

"Laura," he said. "I've brought—" and he opened the little flat plastic box and held out his senior executive's insignia.

"I'm glad," she said. "Father told me you were being raised in rank."

"That's why I'm here," he answered, a little let down that all of his surprises were more or less expected. "You'll do me the honor?"

"I'd be angry if I weren't permitted," said Laura casually. "Stand close, Guy. You're quite tall, you know."

His eyes were level with the top of her head as she stood before him, removing the junior executive's insignia from his coat lapels. She worked deftly, her face warmly placid. She placed the old, plain stars on the table beside her and picked up the rayed stars of the senior executive.

Quickly she fixed them in his lapels, and then stood back a step. She gave him a soft salute, which he returned. Then she stepped forward and kissed him chastely.

"Ah, fine!" boomed the voice of Andrew Greggor from the doorway. "The old ritual! That makes you official, Guy. Like the old superstition about a ship that is launched without a proper christening, no officer will succeed whose insignia is not first pinned on by a woman. Congratulations."

"Thank you, sir," said Guy, taking the extended hand.

"Now," said Greggor, "dinner is served. Come along, and we'll toast my loss of a fine secretarial assistant. Your swivel-chair command is over, Guy."

"We're not sorry," said Laura. "After all, what glory is there in doing space hopping in a desk-officer's job?"

"None," agreed her father.

"He'll get some now," Laura assured the men.

"If those experiments turn out correct," said Greggor to Guy Maynard over Laura's head, "you sure will. Funny, though, I still considered you as my assistant until they handed you the senior's rank."

"Still had your brand on him?" laughed Laura.

"Sort of," said Greggor. His real meaning was not lost on Guy, who knew that the girl's father was only establishing the official facts of his adventure.

The dinner was excellent, and the wines tended to loosen Guy's tongue slightly. He forgot his stiffness and began to enjoy himself. He hadn't realized how much he had missed this sort of thing in the year among the Ertinians. They treated him fine, but he missed the opportunity of mingling with people who spoke his language. He looked at the clock. There'd be dancing later—if he could break away, and he hadn't danced in a solid year.

Marian Greggor said: "You've been gone a long time, Guy. Can you tell me the tiniest thing of your adventures?"

"They were not adventures," said Guy.

"Nonsense!" boomed Malcolm Greggor. "Some of them will be out in the open soon. I'll tell you one."

"Why can't he?" asked his wife.

"He's had his fun—I'm going to have mine," said Greggor, winking at Guy. "He's developed a means of making Pluto a livable place."

"No!" breathed Laura.

"Indeed. Our trouble there has always been the utter cold. Pluto is rich in the lighter metals—lithium, beryllium, and the like. It has been a veritable wonderland for the light-metal metallurgist. But it has been one tough job to exploit. But Guy has invented a barrier of energy that prevents any radiation from leaving outward and passes energy inward. That'll heat Pluto excellently—with the unhappy result that Pluto will be hard to find save by sheer navigation."

"Oh, wonderful."

"There's another angle to that," said Guy. "It'll make Pluto harder to find for the Martians, too. Since the radiation passes inward, the incoming ship may signal with a prearranged code, and the shield may be opened long enough for the ship to get a sight on Pluto. The barrier offers no resistance to material bodies."

"Hm-m-m. We'll score another one for Guy," said Malcolm Greggor. "That'll be a nice nail in the ladder of success, young man. There's one more thing—are you thinking what I'm thinking?"

"Perhaps. May I speak?"

"Go ahead. Marian and Laura will not repeat it. Their interests are clear, and their trust has been accepted by the Patrol. All officials' wives are cleared to the Patrol's satisfaction since we know it is impossible to prevent us from mentioning small things from time to time."

"Yes, indeed," said Marian. "Living with a man for years and years as we do, it would be hard to keep from knowing things. We hear a hint today, another next week, and a third a month from now. Adding them to something we heard last month, and we have a good idea of what the man is thinking of."

"That's not all," laughed Greggor. "Wives have some sort of lucky mental control. Mine, confound it, can almost read my mind —and most of them can almost read their husbands' minds. So go ahead and speak."

"I was thinking of a cruiser equipped with the barrier."

"Is the equipment small enough?"

"Certainly. The size of the barrier dictates the size of the equipment—within limits. Anything from a lifeship—say fifty feet long —to a super battlecraft like the *Orionad*—twelve hundred feet long —can be equipped."

"Fine. And now as to this barring of radiation? How would the drive work?"

"I don't know, not having had the opportunity of trying it out. I doubt that it will work."

"Then the idea is not so good."

"I think it fair enough for a trial."

"But a ship without a drive is useless."

"It has limitations. But it is not useless. Battle conditions may be developed to take the limitations as they may exist. Look. The course of the target is determined—or wait, we must determine the course of the target first. The course of the target is found by lying in wait with detectors. The ship is concealed in the barrier-screen, and the target can not see or detect the sub-cruiser, but the detectors catch the target. The sub-cruiser must remain in the shell, so to speak, until the target is out of detection range. This gives plenty of time to plot the course of the target. Once out of range, the shell is opened and the sub-cruiser takes off on a tangent course at high acceleration. It exceeds the speed of the target, and then turns to intercept the course of the target at some distant spot—calculated on the proposition of the sub-cruiser driving powerless, or coasting. The shell is re-established, and the target and the sub-cruiser converge. At point-blank range, the sub-cruiser lets fly with interferers and torpedoes, and continues on and on until it is out of range once more.

"The target is either demolished; or missed, requiring a second try. At worst, the target knows that from out of the uninhabited sky there has come a horde of interferers and torpedoes, and there is nothing to shoot at. They still do not know which way the blast will come from next. Follow?"

"Sounds cumbersome," said Greggor. "But it may work."

"Is that what you've been working on?" asked Laura.

"Yes," said Guy.

"Sounds as though we have genius in our midst," she answered, flashing Guy a glance that made his heart leap.

"Oh, I—" started Guy, and then

remembered the whole tale again. He couldn't really take credit for this. It wasn't truly his idea; that had come from Ertene. The application of the light-shield had been his, but they were giving him credit for the whole thing.

That was not fair—and yet he knew that he must take false credit or betray not only himself but Ertene, too. And now that his die was cast, he must never waver from that plan. To do so would bring the wrath of the Board of Investigation for his not telling all upon his arrival.

So he stopped the deprecatory sentence and merely smiled.

"—don't think it is too wonderful. It is, or was, but a matter of time before someone else struck the same idea."

"But you were first!" said Laura. "And we're going to celebrate. Mind if I run off with him?" she asked her parents.

She drew him from the dining room without waiting for an answer.

VII.

From Sahara Base to New York is a solid, two-hour flight for the hardiest driver. Maynard was no tyro at the wheel of a sky-driver, and he drove like fury and made it in slightly over the two-hour mark. He let the flier down in New Jersey and they took the interurban tube to the heart of Manhattan.

Guy was proud. Very proud and very happy. The rayed stars on his lapels gave him a lift that acted as a firm foundation for the presence of Laura Greggor, whose company always lifted him high.

Her hand was at his elbow in a slightly possessive manner, and he was deliriously happy at the idea of belonging to Laura Greggor. They swept into the Silver Star, and though he was unknown, the rayed stars of the senior executive gained him quite a bit more deference than he had ever known as a junior. He'd been in the Silver Star before; usually it was too rich for his blood, but he had one year's salary in his wallet, and the increase in rank warranted shooting the whole wad.

He palmed a twenty solar note into the head waiter's hand, and the head waiter led them to a ringside table and removed the "Reserved" sign.

As they settled, Guy said: "'Reserved'? For whom?"

"What?" asked Laura.

"Nothing," said Guy cynically. A great truth had dawned upon him. Before, he had been refused the better tables because they were reserved. Now he knew that they were reserved for the ones who could pay for them. "Dance?"

Laura was peering into the haze of cigarette smoke and answered absently: "Not now. I want a cigarette first."

Maynard handed over the little cylinder and snapped his lighter. Laura drew deeply, and then turned to scan the crowd once more. She satisfied herself, and then smoked the cigarette down to the last drag before consenting to dance.

"I'm a little rusty," he apologized.

"We don't do much dancing in a destroyer."

"I'm afraid not," answered Laura.

"You are as light as ever," he told her. He didn't like the inference; obviously she had been dancing long and often while he was gone.

"Forget it," said Laura, catching his thought. She put her forehead against his chin and sent his pulse racing.

Too soon the dance was over, and he followed her to their table. Guy offered Laura another cigarette, and as he was lighting it, a young man in evening clothes came over and greeted them with a cheery "Hello!"

Maynard went to his feet, but the stranger draped himself indolently into a chair which he lifted from a vacant table adjoining. Maynard shrugged, and sat down, feeling slightly overlooked.

"Hi, Laura, what brings you here?"

"He does," said Laura, nodding across the table to Guy. "Guy Maynard, this is Martin Ingalls."

Greetings were exchanged, and each man took the other's measure. "Senior executive, hey?" smiled Ingalls. "That's something!"

"Oh," said Maynard cheerfully, "they think I've been useful."

"Keep 'em thinking that," suggested Ingalls, "and you'll get along fine."

"He'll get along fine," offered Laura. "But what are you doing here?"

"Oh, Timmy and Alice hauled me in for dinner. They're over there."

"Well! Let's join them!"

Maynard swallowed imperceptibly. He wanted Laura to himself. And here was a young man faultlessly attired in evening clothing who came to a place like the Silver Star for dinner.

He nodded dully, and followed to another table where a couple sat waiting. The man known as Timmy handed over a twenty solar bill and said, laughingly: "All right, Mart. You win."

"What was the bet?" asked Laura.

"I bet Mart that he couldn't get you over here."

"That was a foolish bet," said Laura. "I'm always happy to be with friends."

"We know," said Alice. "But your friend has a brand new set of rayed stars on, and I told both of these monkeys that it looked like a celebration to me—and lay off."

"Yeah, but if there's any celebrating to be done, we can do it better," laughed Martin Ingalls.

"You aren't here alone?" asked Laura.

"I am a recluse tonight," answered Ingalls. "Nobody loves me."

"Liar!" said Timmy. "He didn't bother to call anyone."

"So he's alone," added Ingalls. "And where do we go from here?"

"Let's go to Havana," suggested Alice. "I've been needing some blood pressure." To Maynard she added: "If you know a better way to get high blood pressure with-

out hatred, let me know. Do you?"

"Better than what?" asked Guy.

"Dice. I crave excitement."

"But we just came," objected Maynard.

"You can leave," said Ingalls. "After all, the Silver Star is nothing to get wrought up over."

"Who's to drive?" asked Alice.

"We'll take Mart's junk," said Timmy. "It'll hold the five of us with ease."

"Mine is in New Jersey—we could follow," said Maynard.

"Now I know we'll take mine," said Martin. "It's on the roof. We'll waste no time dragging all the way to New Jersey."

Maynard settled up with the waiter, and within five minutes found himself seated in the rear seat with Martin Ingalls, and Laura Greggor between them. The run to Havana was made during a running fire of light conversation. And from there on, the night became lost to Guy Maynard.

He followed. He did not lead, not for one minute. They led him from place to place, and he watched them hazard large sums of money on the turn of a pair of dice. He joined them, gingerly, hiding his qualms, and played cautiously. He won, at first, and permitted himself to enjoy the play as long as he was playing with the other party's money. Then he lost, and tried to buck up his loss with shrewdness. But skill and shrewdness never prevail against an honest pair of dice, and these were strictly honest. So Maynard played doggedly, and his financial status remained the same. He was a couple of hundred solars behind the game.

He missed the others, and went to look for them and found them dancing. He stood on the side line for a few minutes, until Laura spied him. She broke from Martin's arms and came to him, leading him on to the floor for the rest of the dancing.

The excitement had done its work on Laura. Her eyes were bright, and her hair was ever-so-slightly mussed, which removed the showcase perfection and made her, to Maynard, a glamorous and wonderful thing. His arm tightened about her waist, and she responded gently.

"Like this?" he asked her quietly.

Her head nodded against his cheek. Maynard took a deep breath. "You're lovely," he said.

Laura caressed his cheek with her forehead. "It's been a wonderful evening," she said. "But I'm getting tired. Let's go home?"

Guy lifted his left hand from hers and stroked her hair. "Anything you want," he promised.

"You're a grand person," she said.

The music stopped, and Maynard felt that the spell of the evening stopped with it. They found Alice, Timmy, and Martin at the bar, and Martin called for drinks for them. "A final nightcap," he said, "to a perfect evening."

They agreed to his toast.

"And now," said Martin practically. "As to getting home."

"Yes, indeed. Who lives where?"

"We are in Florida," said Timmy. "We can catch us a cab."

"The rest of us—at least Guy and I are from Sahara Base," said Laura. "But Guy's flier is in New Jersey."

"Shame to make you travel all that way," said Martin. "Should have thought of that when I demanded that we all take my crate. I'm deucedly sorry, Guy."

"Forget it," said Maynard with a wave of his hand.

"I can do this much for you, though," offered Ingalls. "It's past dawn at Sahara now, and since you folks live by the sun, I can imagine that Laura is about asleep on her feet. Look, Maynard, you're used to a rigorous life; you can take this sort of thing. Laura can't. I live by New York time and am therefore several hours better off than she for sleep. I'll run her across the pond, and you traipse up to New Jersey for that flier of yours. That way Laura will get to bed an hour sooner. What say?"

Maynard groped. How could he tell Ingalls that he wanted to take Laura home without sounding like a jealous adolescent? Perhaps he was, but he didn't want to sound childish in front of these people. Ingalls' suggestion was reasonable, from a practical standpoint, but Maynard did not want to be practical. He thought that Laura should have objected; surely she would prefer that he see her home. She *should* prefer it, according to etiquette. But she did not protest, and Maynard sacrificed his desire for the benefit of practicality.

They said good-by, and Laura patted his cheek and made him promise to see her soon. Guy promised, and as she turned away to go with Ingalls, he had a fleeting thought that the pat on the cheek was small solace. Maynard wanted a bit of loving.

Instead, he sat on the far side of Alice from Timmy, and watched Alice doze on Timmy's shoulder all the way from Havana to Miami. Their good-by was quick, and though Timmy demanded his right to pay this part of the fare on the basis that Maynard had a long drag ahead and that this portion of the trip would have been his anyway, Guy laughed and waved the other man out of the cab with a cheery: "See you later!"

Dawn was over New York when Maynard's flier started out across the Atlantic toward Sahara Base. Maynard dropped in his landing-space at Sahara nearly two and one half hours later, and wearily made his way toward home.

The smell of good coffee caused him to stop, and he entered the small lunchroom with remembrance. Coffee and breakfast might take the pang out of the night's lack of climax, so Guy seated himself at the long counter and toyed with the menu. The waitress came forward, recognized him, and said: "Guy Maynard! Well! Hello!"

Guy looked up. The open welcome sound in the voice was good to hear. He smiled wearily and answered: "Howdy, Joan. Glad to see me back?"

Joan leaned forward over the counter and put her elbows down, cradling her chin on the interlaced fingers. "You, Guy Maynard, are a sight for sore eyes. Over at Mother Andrew's we thought you were a real M-12."

"I am," he smiled. Joan and the rest of the people might think they knew the real purpose of M-12. Those who lived within the vastness of Sahara Base had good reason to think as they did, but Maynard believed that this was as good a time as any to dispel that belief. "I am a real M-12. I've been off working on some hush-hush. You're still living at Mother Andrew's?"

"You bet. I'm going to stay there, what's more, until my name isn't Forbes any more," and Joan held up the bare left hand. "We missed you every morning at breakfast."

"I saw her last night. She kept my room in fine shape."

"She's wonderful." Joan yawned. "Tired?"

"Uh-huh. I've been on the dawn patrol. Look, Guy, I'm going off in about an hour. Have yourself a good, hearty breakfast, and you may walk me home. O.K.?"

Guy Maynard looked into Joan's cheerful face and nodded. Joan shook her curls at him, and without asking for his order, she went to the kitchen and was gone for fifteen minutes. When she returned, she was laden with breakfast, complete from grapefruit to toast. She drew his coffee, sugared and creamed it, and then said: "Pitch in, spaceman. Have a good breakfast. I'll bet my hat that you haven't had one like that since you left on that M-12."

Maynard looked the counter-full over and said: "You are right, Joan."

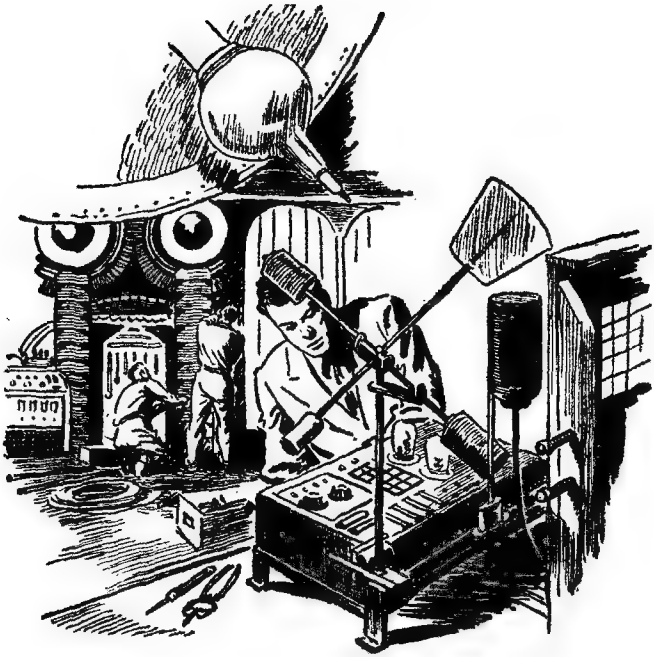
He set to with a will, and when he finished, Joan was ready to leave.

They walked home in almost-silence. Joan knew better than to press him concerning tales of his activities while on the mission, and she was wise enough to know better than to speak of other men and other fun to a man who has been away and at work. Nothing had happened to her worth mentioning, and the rest of her life had been discussed with Guy Maynard long ago.

As for Guy, he felt at ease. He did not know it; he was unaware of the reason for his better-feeling. He did know that the tightness was gone from the muscles across his stomach, and he felt less like running and hiding than he had in hours. He wondered whether the coffee and excellent breakfast had done it, and then forgot about it. He felt too good to wonder why.

They walked in silence and partly in understanding companionship. Maynard knew that he needed no "act" to impress Joan. She would accept him as he was. And when Joan spoke, she directed her thought at him, which made him feel at ease.

Together they entered Mother Andrew's apartments, and as Joan did not dismiss him, he followed up the stairs to the door of her apartment. She fumbled with the key and the door swung open.



"Well," he said, extending a hand, "it's been nice seeing you again."

Joan took the hand and gave it a gentle pressure. She smiled up at him mischievously and said: "Is that the best you can do?" She laughed, but her laugh was gentle.

Instinctively, Guy put his free hand on her shoulder, and her head went back so that she faced him squarely. "You know, I think you've been lonely," she told him. She did not evade him, but went into his arms willingly, almost eagerly.

VIII.

The days that followed were busy, indeed. Maynard found that the increase in rank not only gave him more pay, but more authority too. He was now entitled, by his rank of senior executive, to command one of the speedy, small destroyers, and his command was being prepared for him.

Unlike other, normal commands, the *Asterite* was being fitted with laboratory equipment, and was to be staffed with technical men. Maynard found himself literally swamped with paper work, and he was expected to supervise the installation of the equipment too. But he found time to dine with Kane twice, and the publisher extracted a promise from Maynard that the young officer should co-operate with him.

When the time for leaving was

at hand, Guy made his parting with Laura Greggor at the Greggor home. Laura, realizing that her actions had not been too complimentary to him, was duly affectionate. Guy left there with his heart high and his spirit unbeatable.

He went home and packed, and as he was leaving for the *Asterite,* he paused and knocked on Joan's door. There was no answer, and so Maynard asked Mother Andrew to tell the girl good-by for him.

The elderly woman smiled cheerfully and said: "She knew she'd miss you, Guy. She left this letter. You're to read it after you get aboard your command."

"After?" asked Maynard. "Nonsense." He ripped the envelope and read:

Dear Guy:

I was right. You were lonely. Space must be lonely; even if for no other reason than its vastness. I've been told before, but I didn't realize. You've been lonely, Guy, and you will be lonely again, once you are back in space. I may not keep you from loneliness there, Guy, but please, never be lonely again when at home.

Joan.

"She's a fine girl," said Guy.

"Joan Forbes is one of the world's finest," said Mother Andrew positively. She was gratified to see him put the letter in an inside pocket as he left. What was in Guy's mind, she could not guess, but she believed that he was slightly muddled, for some reason.

Guy was confused. There was something wrong with the way things went, and he was not brilliant enough to understand the trouble. He gave it up as a major problem after trying several times to unravel the tangle.

Then, too, there was no time to think about it. His problem lost importance when displayed against the program he had set out to cover.

And as the miles and the days sped by, the problem at hand became the important thing, and the other problem died in dimness. The *Asterite* moved swiftly out into the region beyond the Belt, and into a completely untenanted region that was marked by absolutely nothing. On his astrogator's chart, a dotted line was labeled Neptune, but the planet itself was almost in quadrature with that position. Pluto was on the far side of Sol from him, and Saturn and Uranus were motes of unwinking light in almost-opposition to Neptune.

He was alone with his crew. They worked diligently, setting up the barrier-screen generators, and when they had them working to satisfaction, they tried variations.

The pilot worked upon their course day by day until it was corrected and stable; an orbit about a mythical point, the centripetal force of the outward-directed drive being in balance with the centrifugal force of their orbit. It made them a neat 1-G for stability, and did not cause them to cover astral units in seconds, or require continuous turnovers for deceleration and return, which would have been the case had no orbit been established.

Their work progressed. The neat, orderly arrangement of the scanning room became slightly haywire as they ran jury-rigged circuits in from the barrier-generators.

No petty quarreling marred their work. This was partly due to the training of the men at Patrol School, and partly due to Maynard's foresight in picking his crew. He had done a masterful job, for in this kind of job, the tedious nature of flight was amplified, and the lack of any variation in the day's duration, or of one day from the one past or the one coming next, made men rub each other the wrong way.

And part of it was due to the nature of the job, enigmatically. They were working on something entirely new. It was interesting to watch the results pile up, and to add to the diary of the experiment the day's observations and the opinions of the workers.

Then as the end came in sight, the inevitable irritation flared briefly as the technician tossed his chessboard aside with a snort and stamped to his quarters. It might have started a long chain of events if a real diversion had not presented itself, right in the technician's department.

Maynard heard the communicator snap on, and listened.

"Technician to Executive: Spacecraft approaching. Range extreme, about one point seven megs."

"One million, seven hundred miles," said Maynard aloud. "Technician: can you get a reading?"

"The cardex is chewing on the evidence, sir," came the reply.

"Let me know as soon as you get the answer, Stan."

"O.K. Here it is. It is the *Loki*, a private craft owned by the publisher, Kane. Want the vital statistics?"

"Forget the color of eyes, weight, and fighting trim," smiled Maynard. "What's his course and velocity?"

"Deceleration at about 4-Gs, course within ten thousand miles of us. Velocity less than a thousand miles per second."

"How soon can we match her speed?"

"Depends upon their willingness. Perhaps ten or twelve hours will do it," answered Stan. "Get your astrogator on it."

"Executive to astrogator: Have you been listening?"

"Astrogator. You bet, and Stan's wild. Make it fourteen hours."

"Executive to pilot: Contact astrogator and follow course. Stan, will you try to contact them? I think it's your job, since they're at extreme range. Communications, you try with the standard sets, but I will not have any tinkering with the set-up in an effort to get another mile of range out of it."

"This is Stan. I have them on a weakling signals, they're asking for you."

"Tell 'em I'm here and we'll see 'em later. Check their course and prepare to match it. Then tell 'em to keep silence. That's an official order. Follow?"

"Check."

Fourteen hours later, Thomas Kane came across the intervening

space in a tender and shook Maynard by the hand.

"Kane! How are you?"

"Fine. And you?"

"The same. But how did you find us?"

"Did a little ferreting."

"Did you know this is restricted space?"

"Sure, but forget it. How's the experiment?"

"Excellent."

"Mind telling all?"

"No. We set up a barrier on the *Asterite*, here, and have been testing and investigating it for months, as you know."

"Have you licked the main bugaboo?"

"We'll never lick that one. The drive, being a type of radiation, will not pass the barrier and so will not drive us. We can not discover a range of radiation that passes outward at all, though there is some minute leakage. The latter is absolutely insufficient to do any good."

"Too bad."

"It is. But the barrier is a good thing."

"Oh, it'll serve in spite of its difficulties."

"We developed the reverse, too. In addition to the barrier, we have what we call a disperser. It is the reverse of the barrier in every way."

"That's interesting. You can drive through that one?"

"Yes, but that's strictly impractical for space maneuvers. You see, both barriers are tenuous with regard to material bodies. A torpedo will pass without knowing that a barrier is there. And no ship can hope to match acceleration with a torpedo, roaring along at a hundred Gs or better. The barrier will keep a ship from detection, but it is sudden death to the ship if its presence is known. AutoMacs will burn the ship to nothing, torpedoes will enter and blast. Even misses with the AutoMacs cause trouble because their energy goes into the barrier-sphere and remains, reflecting off of the insides of the sphere until absorbed by the ship. The trick in use is to speed up and stab with torpedoes, and then continue on your course undetected until a safe distance is covered.

"The disperser screen is opposite. It will protect against AutoMacs or any other energy. It is detectable in itself, since it reflects anything sent against it, and also passes any inside energy right out through the screen. A ship with one of those is bear-meat. The AutoMacs wouldn't be used at all, a torpedo will be shot out to blast it from the universe. No, the disperser is useless."

"Do torpedoes work on the barrier?"

"Not too well," said Maynard. "You see, their aiming and steering circuits are useless until a target is set. Since the sphere is nonradiating, the only way you can fire a torpedo into a sub-ship is to aim it well and drive it into the barrier screen by sheer aim. Once inside the screen, however, it will track the target. It will bar against drive-interferers, too. But take my word

for it, there is nothing good about the disperser."

"How about combining them?"

"We had that idea, too," laughed Maynard. "No dice."

"Why? Seems to me—?"

"When the barrier is equal to the disperser, they cancel, believe it or not. If the barrier is put inside of the disperser, the disperser can not form since the barrier also bars the radiation that sets up the disperser screen. It will also bar the idea of establishing two barriers, too, by the way. On the other hand, if the disperser is put inside of the barrier, they can be held. But—and this is a big but, Kane, energy enters the barrier, and energy emanates from the ship, and there is a stress set up in the volume between the two spheres that sets up a counter force that blows the generators right out of this universe."

"You seem to have seen the whole works," smiled Kane.

"You know, I can't even see the idea of carrying this disperser equipment on a detector to go up in case of attack with AutoMacs, even if it could be made to establish instantly. Just takes up good room—the generators, I mean."

"What's the generating time?"

"Seventy-three milliseconds is the best we've been able to clock. That's a close screen, and it takes considerable stability in the generators to hold it. The best barriers for distance and power establish in point one nine eight seconds. Anything beyond that would require too much holding power, anything closer requires more generator stability."

"How does instability affect the screen?"

"Won't hold up. It collapses, and the build-up begins from zero again. That would be dangerous."

"You've been a busy boy," smiled Kane. "Also a definite credit to us all."

"Thanks."

"And how do you intend to operate this thing in practice?" asked Kane. "Not attack, in defense. I mean?"

"We've got the thing hitched to the finders," Maynard punched a switch. "Now, for instance, if anything that radiates comes within detector-range of us, the barrier goes on. You'll see that everything is tacked down. We've been trying it out with the tenders, and the first time we did it, we went free and everything floated around the place in no-gravity. We're now protected, and if your pilot should kick his drive, we'd go free." Maynard adjusted three dials. "Now," he said, "the spotter is set to neglect any radiation from the *Loki*. We can set up many such channels, compensating for every ship in a flight, and yet have the whole flight protected in case of intrusion by another ship."

"You've got everything all set, haven't you?"

"Just about. If we had torpedoes, we could declare a private war on Mars."

"Then you're about finished?"

"Just about. Want to come in with us, or will you go in the *Loki?*"

"I'll ride with you, if you do not mind."

"Not at all," smiled Guy. "Executive to Communications: Inform *Loki* that Kane will return with us, and to make for Terra immediately."

"Check."

"We'll lose him," grinned Guy. "We're all set for 5-G."

"He'll take it easy, at three. I don't mind."

"Executive to Pilot: Take course for Terra at five!"

"Check!"

The *Asterite* turned and left the *Loki* far behind, and the velocity began to build up for the return trip. An hour later, with the *Asterite* bettering a hundred miles per second, the second incident occurred. It came as a complete surprise, since they were running through a restricted space, and Maynard remarked that it looked more like a public thoroughfare.

The finder-alarm clanged stridently, and immediately the ship went free. Men clutched at the handrails, and as they settled down, the technician took the communicator and started to speak excitably: "Technician to crew: Hold your hats! We're about to be passed by the *Orionad!*"

"*Orionad?* Holy Pete!" exploded Maynard. "See that this confounded screen doesn't fail. If it dies, so do we!"

"Huh?" asked Kane.

"This restricted space was created for the *Orionad* to return through. The nature of the restriction is such that anyone of official nature will be warned, and no civil traffic will be cleared through here. I am here because I didn't think the *Orionad* was due to return yet, and you came because you probably left without clearance. Right?"

"Right."

"Well, the *Orionad* believes that anybody who is in the restricted space is an enemy; spying upon their course. The consequences are clear."

"I hope they hold that screen," said Kane. "But what about Jimmy? My pilot?"

Maynard groaned. "He's several thousand miles behind, and any attempts to save him would fail. The *Orionad* will recognize no incoming signals. Nothing we can do will save him!" Maynard groaned, and then he brightened briefly. "Stan!" he called. "What's the chances of the *Orionad* missing the *Loki?*"

"Not too bad," said the technician. "They'll be running with their finder at cruising range, and they'll just touch us. *Loki* is sliding sidewise and may be out of range."

"We hope. Well, keep it going, fellows. This may be dangerous."

Time passed slowly and ponderously, and the *Orionad* caught up and passed the *Loki* without seeing or detecting the publisher's ship. Of this, Maynard was certain, since the celestial globe would have flared briefly had any action been taken against the *Loki*.

Then as the *Orionad* passed the *Asterite*, Maynard said: "Chalk us

up a win, Kane. Your crate is safe."

"You're certain?"

"I am. *Loki* is now beyond range of our detector, which was souped up and is running at overload range. *Orionad*'s detectors would be running at cruising range, which I happen to know is one quarter meg—two hundred and fifty thousand miles, to you."

"I see. *Loki* is on the far side of us from the *Orionad,* and their distance is such that their cruising range on the detector is less than the distance to *Loki?"*

"Right. And give us another ten minutes, and *Orionad* will go beyond detection range from us. Cruising range, that is."

"Mark yourself up a credit for this one, too," smiled Kane. "If you were an enemy, you could surely score one on the super ship itself."

"Sure could," agreed Guy enthusiastically.

Stan Norman said: "Technician to Executive: May I enter this encounter in the log?"

"Go ahead," said Guy. "They'll never believe us, though."

"Wouldn't a definite statement of their course and velocity be evidence?"

"Nope. I happen to know it. It was part of the maneuver secret that I was kidnaped for, remember."

"They'd just accuse you of telling tall tales that couldn't be substantiated," agreed Kane. "The crew and myself would be considered biased witnesses. I'd sure like to cinch the argument, though."

"So would I," said Guy thoughtfully.

"Do you trust this dingbat of yours? The barrier, I mean."

"Naturally."

"Then couldn't we really do something about it?"

"I don't know what—unless we splashed them with a bucket of paint. We have a gallon of bright red, wire impregnating varnish. Executive to Pilot, Astrogator, Technician, and Observer: Get the course of the *Orionad* to the last millimeter. Both the intrinsic course and the course with respect to the *Asterite.* Then plot a free flight across their path to intercept within a thousand feet at thirty degrees angle. You know the standard attack problem as we have designed it; this is an applied problem, fellows. We're going to label the *Orionad!* And when they land, they're going to bear the *Asterite*'s trademark, and they'll not know it until we make Terra. Like?"

"We're on it now," said Stan.

"And working in nine decimals," added Astrogator Cummins.

Technician Norman stretched his back, and started to gather his tools. "So far," he told Maynard, "every instrument we need has been checked and corrected to the last micron. Turretman Hastings and Machinist Trenton have converted one of the mounts to a spring-loaded gadget to propel a gallon-sized cannister of plastic material. Adkins has just cemented such a cylinder together and filled it with

the wire gluck. I hope we hit the main personnel lock; it'll stay glucky until they land, and that wire-impregnating googoo ranks high among the things I wouldn't care to bathe in."

"It ranks top with me," said Maynard.

"To me, it is outranked only by chewing gum and rubber cement. But anyway, we're ready, all of us."

"That correct?" asked Maynard of the crew.

A series of "Check" shouts came in ragged confusion.

"O.K. Start going!"

With the instruments under personal supervision, the *Asterite* accelerated in a wide circle, and then corrected the side-vector component of her course.

Then for an hour solid, the *Asterite* accelerated on a die-true course. The components of the intersection were complex because the *Orionad* was in deceleration all the time, while the *Asterite* was in acceleration, and would be picking up speed until the barrier established; then the little destroyer would coast free, crossing the *Orionad*'s course at the precise instant that the super ship came to the course of the free-flying *Asterite*.

The last driving moments of the *Asterite*'s maneuver passed. The barrier went on, and the tiny ship went free. Time passed, and eventually the *Orionad*, long beyond detector range, came into the scope of the *Asterite*'s souped-up finder.

Furious and extensive checking on the part of the crew resulted in the information that everything was going according to plan.

More time passed, and now within sight, the two ships were converging. They became tense, a single moment of failure would be death for all. But the barrier held, as they expected it to, and with lightning velocity, the two ships crossed at thirty degrees angle.

"Fire!" called the technician.

"Stick to your meters," drawled Turretman Hastings. "This is a job for an eyepiece and fingertip man. A man, may I say, with eyes in his fingertips. A man, may I add . . . Ughn. There she goes, fellers! . . . who is capable of doing things based upon the excellency of his coordination."

"What a line of baloney," snorted Norman. "Did he follow through on that malarkey?"

"And, may I add," drawled Hastings, "a man who never claims ability beyond his capability? Who never claims that which he is unable to produce. The *Orionad* is now bearing a great, ugly, irregular circle of bright red, gooey paint."

"Are they aware?"

"Apparently not," said Technician Norman. "Also, the projectile we tossed at them is nondetectable and nonradiating, and was in the separation-space too briefly for observation. Another thing, we hit 'em in a blind spot."

"Blind spot?" asked Kane. "I didn't know she had any."

"She hasn't. What I meant was that we hit 'em in a bald spot. They'll not see the mess until they land. Pilot, how're we doing?"

"Fine. We're coasting away at a great rate."

"Well, get this barrier down as soon as you get out of range. Wait until you are out of operating range, but don't worry about extreme range unless you think they smell a crate full of mice."

"Right-o."

"You know, Kane, that was fun, sort of. But I hate to think of what they will say back home. I'm liable to get busted right down to a junior aide again."

"They can't break you for that kind of demonstration," said Kane.

"Yes they can. I'm still at the mercy of my superiors."

Kane smiled. "No, you're not. I forgot to tell you—or you didn't let me get to the point of my coming. But, Guy Maynard, since the successful establishment of the Plutonian shield, you are now a sector commander. That gives you—"

"Im what?" asked Maynard.

"A sector commander. Here, if you don't believe me," and Kane handed Guy a tiny box. Guy opened it, and found lapel-insignia; the circling comet of the sector commander. In Kane's other hand was an envelope stamped "Official" which contained official notice of his advance in rank.

"That puts you in the upper bracket," said Kane. "You are now on your own, Guy. Any demonstrations you may give will be viewed officially, and this is no longer a prank, but a self-assertion; a very definite evidence of your ability to accomplish the difficult."

The barrier dropped, and the celestial globe traced the last indication of the receding *Orionad* to the surface of the clear, glassite sphere.

Maynard touched his hat in salute to the *Orionad*'s last glimmer and said: "Hi!"

IX.

The *Asterite* beat the *Orionad* to Terra by a few hours, and in sufficient time for the report of Maynard's trip to be reviewed by the Bureau of Ordnance. When they came to the incident of the painting, they laughed first, and then called Malcolm Greggor to ascertain the moment of the *Orionad*'s landing. Armed with the information they went to the big landing area at Sahara Base, and waited for the big ship to touch.

Greggor was there; he arrived almost as they did.

"What's the meaning of this?" he stormed.

Patrol Marshal Mantley grinned at the irate man and answered: "Your erstwhile employee has demonstrated his sub-screen to excellent effect, Greggor. He hung a gallon of red paint on the *Orionad* without their notice."

"This is preposterous!" exploded Greggor.

"Not at all," said Mantley. "Sector Commander Maynard was merely bringing home the effectiveness of his own invention. If he can do that to the *Orionad*, no Martie can hope to best us. You must admit that he has something good."

"That I admit. But to play such a prank—"

"No prank, Greggor. This was a very convincing demonstration. How can you possibly classify such an epoch-making act as a prank? It is deplorable that your pride and joy should be thus decorated by a mere . . . he was but Senior Executive Maynard at the time . . . destroyer, a spacecraft one tenth the tonnage of the *Orionad*. But I insist that it does not detract from the pride of the *Orionad* to have been bested by such a weapon."

"I feel as though I've been made a fool of."

"Ridiculous! It is not an admission af defeat to acknowledge a minor defeat at the hands of a man who is responsible for making Pluto inhabitable. After all, Greggor, Maynard is one in fifty billion."

Greggor smiled wryly. "When you put it that way, I must admit," he said. "Any man who can bring the means of warming a planet to human climates certainly must be capable of decorating the *Orionad*. Maybe I should grow angry again; why should such a genius stoop to tamper with my ship?"

"It was available and the best thing we have to boot."

Maynard interrupted. "Surely you would not believe me capable of bringing ridicule upon you, Marshal Greggor. It was but a splendid opportunity to demonstrate what could have been done to an enemy with a torpedo. What if I had been a Martian?"

"I agree," said Greggor. Then he laughed uproariously. "We'll pink Patrol Marshal Inkland with the idea," he said. "Tell him that his ship was destroyed in space by a real destroyer; that he must have been asleep. Roast him good, and see what happens. Here she comes —and Maynard, that splotch of red paint sticks out like a miniature sun. What a mal-beautiful job of decoration."

The *Orionad* landed, and Inkland came across the sand toward the little group as soon as he saw who it was. He shook hands all around and smiled until Greggor told him of the decoration.

Inkland turned red and blustered. "Nothing was within detector range of me!" he insisted.

"That slab of red paint says you're wrong," said Greggor sternly.

Inkland inspected the red paint from where they stood and was forced to admit that *something* had been close enough to do it while in space. "Who did that?" he stormed.

Mantley indicated Maynard, and Inkland strode over to Guy with murder in his eye. "You insolent young puppy—I'll see that you lose your rank, senior executive." He whirled to the assembly and said: "No matter what was done, the fact that a mere senior executive did it is good enough to prove that it was a prank—"

"Just a moment," snapped Maynard. "First, I resent being called a puppy. I dislike being called insolent. And third, I defy your intent to deprive me of my rank!"

"Why you—"

"For your troubles, Patrol Marshal Inkland, I shall consider my success complete upon the day that I command the *Orionad* myself!"

"Ridiculous."

"Inkland," said Mantley softly, "I would speak more even. You are at fault, and the fact that Sector Commander Maynard has decorated your ship in a complex space maneuver of his own device should bring praise from you instead of hatred."

"Sector Commander?" asked Inkland.

"His insignia has not been properly installed," said Space Marshal Greggor with a fatherly smile. "But his rank has. And if young Guy Maynard puts his aim at commanding the *Orionad*, I'm beginning to believe that I would start looking for another job, if I were you."

Inkland turned upon his heel and left, with no further word.

The group of high-ranking officers followed him at length, leaving Maynard to watch the mighty *Orionad* being serviced and unloaded. He stood there for some time, relaxing and enjoying the fresh air and watching the operations. He found a comfortable spot, and seated himself lazily.

He did not sleep, though he did drowse a bit, and a sparse circle of cigarette butts began to surround him. He did not care; his last sojourn into space had made him appreciative of the comforts of just being on Earth where he could watch the sky and the ground meeting at the horizon.

He was not molested; though many people came to see the monster *Orionad*, none bothered him until the day wore into late afternoon. His first visitor was Laura Greggor.

"Guy," she said. Her voice was neither sharp nor inviting, but rather a flat tone of greeting.

Guy leaped to his feet and reached for her hands. "Laura!" he breathed. "It's good to see you!"

"I thank you for that," she said coldly.

"Why," he asked her, "what's the matter?"

"Guy, before I go any further, I want to know something. Did you, or did you not decorate father's ship?"

"Why," he answered proudly, "I most certainly did."

"I didn't believe it of you," she said sharply.

"There was nothing wrong with it," he said. "It was the best thing that happened to me."

"You believe that?" asked Laura.

"I certainly do. After all, it proved the worth of my invention. And," he added eagerly, "it gave me another set of insignia to have installed."

"If the worth of your invention is more interesting to you than the interest of my father's office," said Laura sharply, "your latest rise in power—made by using father's finest ship as a stepping stone—is of little interest to me."

"But Laura. I'm a sector commander now. And you may have my senior executive's stars."

"I have a fair collection," said

Laura coldly. "You may bring me your patrol marshal's nebula when you're raised to sector marshal. Good day!"

She stamped off angrily, and Maynard searched his mind for the answer to the question, and gave it up as one of the unanswerable mysteries of life. If Malcolm Greggor could look upon the incident without rancor, why should she turn upon him? Any reasoning he did made no sense.

And as he stood there, footsteps made him aware of another visitor. He turned to see Joan Forbes.

"Hello," she said brightly. "I was on my way to the lunchroom and passed by to see the Big Fellow." She indicated the *Orionad* now being illuminated by mighty floodlights in the dusk. "I found you instead."

"Hi," he said to her. "What's new?"

"Nothing in my life," she said with a broad smile. Her eye caught the boxed insignia in Guy's clenched hand. "I see that something is new in yours. May I salute you, Sector Commander?"

Guy looked at her with a half-smile as she stepped back and cast him a womanly salute. "Congratulations," she said, offering her hand.

Guy looked first at her face, and then at her outstretched hand. Instead of taking it in his for a handshake in friendship, which was the manner of its offering, Guy placed the opened box in the outstretched fingers.

Joan blinked, and looked down at the box in surprise for a moment. Then she brightened.

She stepped forward and removed the rayed stars from Guy's lapel and replaced them with the circularly tailed comets. She stepped back, saluted him silently, and then came forward and kissed him on the lips. Her caress was affectionate, but brief.

"You're properly installed, commander," she told him. "But if I don't hurry, I'll be un-installed by my boss. I've got to run along. Keep rising, Guy!"

And with that she was gone.

Guy looked at the empty box, and then at the comets on his lapels.

And from them, across to the *Orionad.*

And a challenge arose to confront him. He would be sector marshal one day, and whether he took his patrol marshal's insignia to Laura Greggor depended only upon her. And he would also command the *Orionad.*

He clenched his fist upon the empty box, crushing it. His question was not: Would he command the *Orionad?* It was: How long would it take?

It took five years. Five long, toilsome years.

But five years of constantly increasing, constantly expanding, constantly improving. He never forgot the day of the *Orionad*'s landing in all that five years, though there was evidence that Laura Greggor had been reprimanded by Malcolm Greggor for her actions. But Maynard remembered, and it was Joan Forbes that pinned the silver nebula on his lapels—in public as befitted a Patrol Marshal—just before he stepped aboard the *Orionad* to take his first major command.

He hoped that Laura Greggor remembered.

Then the *Orionad* sped into the sky above Sahara Base on the way to Pluto.

Guy Maynard was on his way to the top. Ertene was a dim remembrance by now, and though he could almost pick out the spot of the nomad planet's present position, it occurred to him only at odd intervals. Ertene was gone. But the strength of Ertene's knowledge was serving both him and Terra, and her brief visit was not wasted.

Maynard lost himself in reverie for a half hour, relaxing in the luxury of the master's office aboard the mighty *Orionad.* Then Guy's active mind asserted itself, and he called the chief technician for a conference.

Senior Executive Martin Carrington entered the office and stood at attention, and Guy recalled briefly that on his first command, he had been of the same rank as his chief technician now. Then he asked Carrington to be seated.

"Carrington, I've been worrying."

"Worrying, sir?"

"Suppose we are attacked by a sub-ship? How may we detect him?"

"You are supposing that the Martians gain the secret."

"I fear they will, some day. We

haven't all the brains, you know."

"But a Martie, sir?"

"They may capture one of ours by a fluke. Then we'd all be bear meat."

"Hardly possible, sir."

"Then accept it as hypothetical, Carrington. Take off from there and answer my question."

"That I cannot do, sir. Frankly, I do not know."

"Then listen. I have an idea; I want you to pass on its value."

"I shall try, sir."

"Carrington, is it possible to establish a celestial globe that is capable of giving a negative action? No, wait, I'll explain. Our present celestial globe is positive; it operates by three-dimensional fluorescence in the sphere, glowing when a positive radiation comes in from a spaceship. What I want is a negative indication; one that will glow in any location from which there comes absolutely zero radiation. Is that possible?"

"Hm-m-m," mused Carrington. "Our present level of detection is based upon the maximum level of celestial radiation, which is fairly constant in all directions save Solward. Your supposed sphere would operate on the celestial radiation—with the normal globe the entire sphere would glow—and be dark everywhere except in a place where all radiation were absorbed. It would be devilishly ticklish, sir."

"You follow my reasoning?"

"Oh certainly. Your idea is to prepare a sphere that glows with no signal. That can be done with a local signal, which is cut when no-radiation enters. Hard to say in words, isn't it?"

Maynard laughed cheerfully. "As long as you get my thought, I don't care how you say it. The barrier-screen absorbs all radiation. Therefore any position holding a sub-ship would produce zero radiation. It would then show on the negative sphere. Right?"

"I think that's about it," said Carrington.

"Good. We agree on that. Want to work on it?"

"Absolutely."

"It's yours, then. Go ahead and make it tick."

"That I'll do, sir. We'll have it by the time we hit Pluto."

"One more thing, Carrington. Keep it under your hat. It's a military secret, you know."

"I'll say nothing."

"Check. I'll be down and see you later."

Carrington left, and as he went back to his quarters, he told several of his contemporaries that the new commander was everything that they had ever heard of him.

Finding Pluto was a good job of work for the combined efforts of the astrogator and the chief pilot. Pluto was completely hidden just as Ertene was, and Maynard knew the completeness of that shield. It was done gropingly, by sheer hit and miss effort, but finally a black circle in the starry sky established above them, and as the pilot announced his success, it began to spread from a minute spot to mightiness. Then they passed through the

barrier, and Pluto was a warm, greenish planet above them, much the same as Terra as seen from Luna.

The *Orionad* dropped onto the spaceport; the entire trip without incident.

Maynard signed his command into the base marshal's office and ordered his chief executive officer to grant planet liberty as he saw fit. Space Marshal Lincoln smiled at the younger man and told him: "I think you'll be interested in the experiments going on in the radiation laboratory."

"Yes?"

"They're having a bit of trouble on one of your gadgets."

"Which one?"

"The stellar light filter. Somehow, it doesn't work as you predicted."

"Why didn't they ask for me sooner?" wondered Maynard. "It's been six years since I thought that one up—they've had plenty of time."

"It's possible," admitted Lincoln. "But you forget that it was extremely complex and highly theoretical. Also, no good use has ever been found for it. Unlike your other inventions, this seems to be an experiment in pure research. So we didn't start on it until last, and it's been three years in the building."

"So long?"

"Oh yes. Some of the parts were entirely unheard-of before, and many of the major components had to be built of parts that were designed for the job. When you design the minor components to assemble the major components—which also require design—you pyramid the time and difficulty."

"I hadn't thought of it that well."

"I wish you'd go over and tell them what's wrong. Kane, the publisher came in for the unveiling of the thing, and we'd hate to present him with a complete failure, in spite of its uselessness."

"Kane's here? Good, I'll go right over."

Maynard was youthful enough to be amazed that the weight of his rank opened a path through the grouped technicians to the complex instrument that lined the entire wall of the huge laboratory. Kane was near the center, and the only one in the group that knew Guy Maynard well enough to call him by his first name: therefore he was the first to speak.

"You invented this thing, Guy. Can you make it work?"

Guy blushed. "I didn't invent it—" he started and then saw Kane's puzzled look, which caused him to pause; then he nodded and finished: "—I merely worked on it theoretically. I did not have enough equipment in the lifeship to build any more than a few of the more complex circuits."

"Good enough," laughed Kane. "Well, you may know more than we do at that. After all," he said in defense of his statement, "these men have been working on it for a couple of years."

A man with the rayed stars of a senior executive offered: "That's not strictly true, Mr. Kane. We

started to work on it about three days ago—if you consider the instrument as a whole. There have been many groups working on the components separately, building them up. We assembled the whole last week."

"Take a swing at it, Guy."

"It's a maze to me," admitted Guy. "Let me see the circuits."

It took Maynard some time to figure them out. He was working from memory now, and it was none too good, plus the fact that he had memorized the complex circuit in Ertinian symbols and in Ertinian constants, and they all required conversion to Terran terms. He called for the group leaders of the various components, and asked them to report on the functions of their parts.

Together, they pinned the error down, and corrected it. Then Maynard turned the thing on himself.

The broad plate took on a gray-green background, mottled with huge circular blotches of white. He turned the focusing knob, and the mottling contracted into individual circles of intense, flaming white. He reduced the intensity control, and the eye-searing brightness dimmed to a more comfortable level. More fiddling with the focus, with alternate adjustment of the intensity, for they were inter-reacting, and the plate took on the appearance of the sky.

"So far so good. Now for the shaping control," said Maynard. He drove the left hand end swirling upward on the plate with one knob, stretched the stars across the top of the plate, and compressed them along the right side. He caused them to whirl circularly, and gradually the distortion dropped until the constellations appeared.

"There you are," he told the chief technician.

"Fine. Now what can we do?"

"Well, there aren't too many planets," said Maynard. "We can decrease the response of celestial bodies that shine by reflected light. That one," he said needlessly, since they all knew it well, "is Jupiter. Watch him fade!" and Maynard turned the knob. After the demonstration, he returned it to its original position again.

"On the other hand, we have a lot of stars," he said, turning the other knob. The starry heavens faded, leaving a widely scattered group of pinpricks grouped about a deeper black disk. He pointed to the disk and said: "Since it is the brightest, we may expect it to be the darkest too. Can't beat Sol from here. At any rate, this knob causes the fading of all bodies that shine by intrinsic light. The reflected-light bodies remain, so."

"Marshal, sir, there are nine of them," said the technician.

"Well," interrupted Kane, "there are nine planets, aren't there?"

"Not from one of them," answered the technician. "Or," he asked Maynard, "would we appear along with the rest?"

"No," said Maynard slowly. "You're right. There are nine planets, which counting the one we're on makes a total of ten."

"You realize what you're saying?" stammered Kane. "That means you've discovered a new planet with this gadget."

Maynard shook his head in dazed unbelief. "Another planet?" Then he shook off the amazement and said: "It may be so. But before we shout too loud, we must investigate and be certain."

"Of course."

Maynard turned the stellar intensity knob up slightly, bringing the stellar background into faint light. "Get the constants of that planet, and we'll check. Kane, you'll come along as a representative of the Terran Press?"

"I wouldn't miss it for the world itself," said Kane. "Any chance of missing it?"

"If we get the linear constant of that planet from Pluto, here, we'll line-drive out there. Once within a few million miles, passing by if need be, we'll know it."

"Couldn't we pack this thing aboard the *Orionad?*"

"Not unless we tear the side out of the ship," grinned Manyard. "We'll fly this blind, and that won't be too hard."

"And then we may find that planet is but a flyspeck," said Kane.

"It could be," agreed Maynard. But he knew better. He was thinking of a huge panel; a brilliant painting in a vast hall lined with paintings. The one he faced showed Sol—and *ten* planets.

And Maynard had patiently waited for all these years for the stellar light-filter to be built. He knew that the unknown planet was so far from Sol and at such an angle that it would remain unseen until they made the filter work. After all, it had been unseen for hundreds of years during the advent of space travel, and for hundreds of years of pure stellar research from Terra before space travel gave the astronomers a chance to prove their planetary theories. He had not been worried that his find would be found too soon, but he would have broken all rules to get to Pluto at the time he did. Luckily, there was no reason to break rules.

Now he could go anywhere and do anything except the short periods when he was under explicit orders.

He wondered whether his action had been too abrupt, and then remembered that his position permitted a large amount of snap-decision and some eccentricity. The quickness of his action would add to the legends of one Guy Maynard, and would cover up the fact that he had been planning this particular party for years.

At the end of the usual landing duration, Guy gave orders for the *Orionad* to go out to the new planet.

X.

Die-straight, the *Orionad* flew. On a course tangent to the orbit of Pluto, on and on and on beyond the limits of the Solar System, out to a position almost twice the distance from Pluto to Sol; a distance of 7,180,000,000 miles. And there Maynard looked down upon the globe of another world.

"There it is," he said to Kane in

what he hoped to sound like awe.

"I'd never have believed it," breathed Kane.

"The funny part," said Maynard in a surprised tone, "is that this planet is about the correct distance for agreement with Bode's Law for Pluto, which is not met. Wonder why it never occurred to the brass hats to look in the 'Bode Position' all the way around."

"Neptune sort of screwed Bode's Law up," smiled Kane. "It is the fly in the ointment. If you set up Bode's Law and check for Neptune, you find that Pluto occupies that position, while Neptune is in a supposedly unoccupied position. Neptune is an interloper."

"Wonder why he came," mused Maynard.

"Probably got here and couldn't leave," said Kane. "Well, Guy, if nothing else, you've re-established the value of Bode's Law. Proper continuity on either side of a discontinuous section—Neptune—indicates to me that the Law is correct. It is the presence of an alien planet that is the troublemaker."

"Is there anything on that planet?"

"I wouldn't know. Has three moons, though. Guy, how could anything live on this planet . . . you're entitled to name it, you know, since you discovered it."

"I discovered it?"

"You'll get the credit, and not without reason, Guy."

Guy shrugged. "We'll call him Mephisto. I'm going to run in close, Kane. I'd like some initial information on this planet before we return." He called into the communicator: "Marshal to Executive: Until further notice, we shall call this planet 'Mephisto.' Therefore, circle Mephisto at one thousand miles. Have the technician's crew take all data possible. Have the astrogator check his constants, and if possible, get an initial estimate of Mephisto's velocity, orbit, and ecliptic angle."

"Executive to Marshal: Check."

The answer to Kane's idle question as to the possibility of Mephisto being inhabited came with a distinctness that left no doubt. Not only was Mephisto inhabited, but Mephisto harbored intelligent life. And the intelligent life either resented the arrival of the *Orionad*, or thought that the *Orionad* was the vanguard of a special invasion.

At any rate, both were correct. And no matter what the inhabitants of Mephisto thought, they acted.

The detectors rang in alarm, and automatic circuits closed. The big turrets of the *Orionad* whipped around with speed enough to warm their almost frictionless bearings in the brief arc. They threw their surge on the ordnance-supply lines, and the meters jumped high. The big AutoMacmillans emitted their energy silently and invisibly, and seven great gouts of flame bloomed in the space between Mephisto and *Orionad*.

They swiveled slightly and fired a second time, and four more blossoms of flame spread, this time closer to the *Orionad*. Upon the third attack, the flashes were very close to the super ship.

"Ships—or torpedoes?" asked Kane.

"Torpedoes," said Maynard definitely.

"How can you tell?" asked Kane.

"Ships would have flared less brilliantly and more slowly. It takes a well-loaded warhead to blast that way. The fierceness and the velocity of the blast give the answer to that one. Also, those things were coming up at better than a thousand G, all the way. That's guessing that they all started at once or nearly so. In order to separate that much in the distance they covered, and to cover so much distance between the first, second, and third contacts, the acceleration must be about that high." He snapped the communicator and asked: "Marshal to Executive: What was the acceleration of the exploded bodies?"

The answer came immediately. "Approximately, 941-G, according to the recorders on the detector circuits."

"Good eye, Guy."

"Lots of practice," said Maynard. "Well, we're heading back. I'm not going to risk the *Orionad* in a single-handed battle against a whole planet. Even if I won, they'd bust me flat. We'll head for Terra and set us up a real punitive expedition. Then we'll return and take Mephisto for Terra!"

The *Orionad* based at Sahara Base and Maynard went into the Bureau of Exploration building. His entry into Malcolm Greggor's office was easy, and he told the space marshal about his discovery. Greggor's reaction was first doubt, but Maynard called Kane and his executive officer, and when Greggor was convinced, his excitement knew no bounds.

He called an immediate conference with the head of several bureaus, and told Maynard he was to remain, and then added Kane to the list. Once assembled, Maynard explained the details, complete, and Malcolm Greggor opened the discussion by stating: "This will be difficult. They resent us. If we go in at all, we must go in armed to the teeth, and expect trouble all the way."

Mantley, of the Bureau of Ordnance, said: "You expect anything unique in ordnance, Maynard?"

"I hardly think so. On the other hand, they have space travel, as witness those torpedoes. They must have a definite isolation policy, otherwise they would have contacted us long ago."

"Not necessarily," objected the head of the Bureau of Exploration. "They may be alien—they must be utterly alien to inhabit a planet that far from Sol. What form they take, or what their chemistry might be, I have no idea. Furthermore, I don't care, and if I ask about it, it'll be academically only. They exist, they have science. They do not like us. Perhaps they know of us, and realize that any traffic with us of the inner worlds is impossible."

"Their attitude in firing upon the *Orionad* gives us no alternative," said Mantley. He turned to Garlinger, and asked: "We haven't

heard from the Bureau of Maneuvers, yet. Have any ideas?"

"It'll be out and out war," said Garlinger. "I'm certain that we made no warlike move in merely visiting them. They've been in preferred isolation, and now that we've discovered them, they fire on us, without provocation. My guess is that we'd not only be better off going in armed, but we'd best prepare for countermeasures, counterattack, and all the trimmings. Now that they've been smoked out, I'll bet they won't sit there on their icy planet and wait for us to come a-blasting."

"How and why have they developed space travel," asked Greggor, "if they care nothing for interplanetary commerce?"

"Their moons," suggested Kane. "There were signs of inhabitation on all three of them."

"This is going to be more difficult that I thought. The problem of breaching a planet alone is one that has seldom been tried. But if Mephisto has three armed moons, that's another item to consider. Well, fellows, it has never been Terra's way to go in with less than all we have. If we have ten million men that never see Mephisto from anything but the viewports of the transports, we'll be better off than if we were blasted to every last man for not having enough of them. It'll be a full-scale attack, gentlemen."

"More than that, Garlinger, we'll get lots of practise."

"Meaning?"

"Some day we're going to be forced into fighting Mars on an all-out basis. This will be excellent experience. I believe that Mars will be the harder to fight, gentlemen. After all, knowing your enemy makes the battle easier—and they know us very well. So if we correct our mistakes on Mephisto, and take the resulting plan to Mars, we may break this deadlock between Mars and Terra forever."

"No one here doubts that it will be an all-out attack," said Mantley. "We'll have to mobilize—and that's your job, Donigan."

"Yup," drawled Donigan. "After you boys get all done making your plans, you hand it to me. Uh-huh—and after I get 'em, it's war with a capital W. Gentlemen, is it your wish that the Bureau of Warfare take over from here on in?"

"It is."

"My aides will present to you the requirements of the Bureau of Warfare as soon as they can be pulled from the files. You will break the news," he said to Kane, "immediately, and in headline form only. Mere mention, in this case, of the new planet, and Guy Maynard, the discoverer. Meanwhile I'll have the Bureau of Propaganda prepare a news-campaign for you, which you will follow within reason."

"With nothing to print but the mere discovery of Mephisto," smiled Kane, "I'll be forced to play up Patrol Marshal Maynard. That all right?"

"Oh certainly. After all, he's fairly well-known and it will seem only right that a well-known figure

gets the limelight. I see your problem; you can't break a lonely headline."

"I must at least fill up one column, and even with eighteen point type it takes words. We'll prepare the way, though."

"I want Maynard," said Donigan suddenly.

"The Bureau of Warfare runs this show," nodded Mantley. "May I ask what for?"

"He'll command one phase of the attack. And it will look well that the discoverer leads the battle. It implies that we have implicit confidence in him, in spite of his youth."

"Will he require an increase in rank?"

"Not at the present time. That will come as necessary. But let's close this. Time is important; Mephisto will be mobilizing even as we are."

"May I use the official wire?" asked Kane. "And one more item. What about secrecy?"

"A thing this big can not be kept a secret," answered Donigan. "We haven't enough men and materiel to successfully attack a militant planet. Therefore we must recruit men, and get the manufacturers to produce supplies. Mars—I believe—will sit tight and wait until we take the initiative. A move on their part will hinge upon our success or failure on Mephisto. Break it wide and big, Kane. And send it out on the interplanetary service. Mars may as well have something to think of. We know she will never attack Terra as long as the Terran Space Patrol maintains a fleet. Mars is too small and, therefore, too easy to cover compared to Terra. Go ahead and break your story, Kane."

Kane was as good as his word. It hit the newsstands that evening, in three-inch headlines. They said nothing more than the hourly newsbroadcasts for news, but Kane's writers had done an excellent job in building Maynard up as the man of the hour.

And then the report of the attack followed. Guy Maynard, commanding the *Orionad,* had been fired upon without provocation as he attempted to run in close to the new planet for photographic records. The bursting of the torpedoes was pictured in the newscasts in all their blasting flame, and the pictures suffered nothing from the film record.

Guy Maynard was then called upon to face the iconoscopes. He looked into the faces of three hundred billion Terrans and told them simply and forcefully that Mephisto's military action prevented any peaceful negotiations, and that it was certain that they were even now preparing to maintain their isolation.

"And," he finished, "we know that isolation can not be defended. To preserve isolation, the enemy must be destroyed on his home base. We can expect attack from Mephisto unless we tackle them first. And to take the battle from Terra to them, we need men, material, and all the myriad of things that follow."

The recruiting posters hit the public next, and all of the machinery of war was started. And though it

rolled in the super-slow gear at first, it would pick up momentum as time went on. All that the Patrol needed was a backlog to replace losses, and with that assured within the next few months, the mighty fleet of the Terran Space Patrol assembled at Sahara Base, formed a complex space lattice, and drove outward towards Mephisto.

Inexorably, the Terran battle fleet drove onward. Massively ponderous; immobile in its chosen course, the massed fleet flashed up through the velocity range to mid-course, made their complex turnover, and started to decelerate. Hours passed, grew into days, and the days added one to the other, and the lattice was maintained with precision and perfection. Hardly a centimeter of vacillation was observed from ship to ship, and from the *Orionad* in the center of the space lattice, it seemed as though the monstrous, assembled fleet were truly set in a huge glasslike jelly, immobilized.

But it was a wary personnel that manned the huge Terran Space Patrol task force. They expected something. And the fact that so many hours and days had gone without interruption did not make them less restive. Each moment that went without trouble brought more certain the chance of excitement in the next. It was a beautiful war of nerves, with the Terrans getting more and more certain of attack as the hours sped on and the fleet's velocity dropped to far below the lightning-speed of the maximum at turnover.

Strange Fish . . .

In which Doc Savage meets a "belonesox". . . .

Is it sausage? Is it hosiery? Or is it—violence and murder?

When, for no earthly reason, terror begins to stalk a beautiful girl, Doc takes over. What is the sinister plot he discovers and how does he outwit those who are schooled in murder?

Find out in STRANGE FISH, in the February issue of

DOC SAVAGE

AT ALL NEWSSTANDS

The watch was not stirring, save that the crews were on the constant alert for the clangor of the alarms; and the detectors were operating at overload range which gave them plenty of time to get into action—barring something superior in the way of weapons. Far better than human senses were the detectors, and they could be relied upon.

Surprise was impossible because attack was inevitable. And since the human element of watching was eliminated by the ever-alert detectors and the element of counter-attack was automatic with the turret-coupled AutoMacs, it was only a matter of time. As one, the fleet moved through the vastness of space between the orbit of Pluto and their goal.

Guy Maynard prowled his scanning room impatiently. In the easy-chair beside the broad desk, Ben Williamson lazed without apparent excitement. Upon the twentieth cigarette, Ben said softly: "You should take it easy, Guy."

"Like you?" asked Maynard. "You look calm—but!"

"I know all about it. But remember, even though it's action you crave; you're the big boss on this expedition and you'll be able to do nothing but watch."

"Watch—and pray that my plans are effective. Uh-huh. But talking it down won't lessen the tension."

"Wait 'em out, Guy. They'll come soon enough."

Guy snorted, tossed his cigarette into the wastebasket and tried to relax. A matter of time, all right. Well, maybe he could wait in patience. At best he'd have to wait until the Mephistans were ready to attack.

When it came, it was swift to start and equally swift to end. From one side there came a fast-moving jet of tiny spacecraft. At unthinkable velocities, the thin stream poured into the space pattern of the Terrans.

The clangor of the alarm ceased as contacts were opened. The communications band roared with cries and questions.

"Who got it?"

"*Scorpiad!*"

"Bad?"

"Not yet."

"Get out the fighter cover!"

"They're coming—give us time!"

"Time, hell! This is a space fight, not a pink tea!"

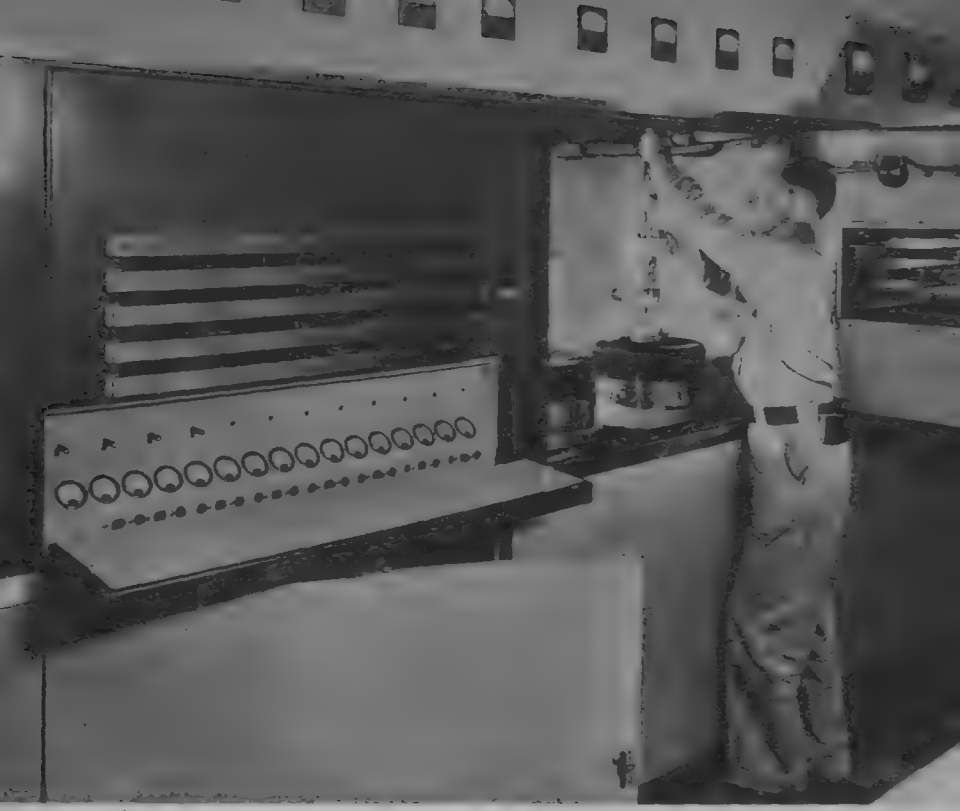
The turrets of the *Scorpiad* danced back and forth in a mad pattern. At the end of each lightning move they paused. At each pause they vomited unseen energy that catapulted the temperature of the Mephistan ship into incandescence.

The sky beside the moving fleet was dotted with winks of light as the fencing AutoMacs parried the rapier thrusts of the tiny fighters. More ships poured into the arrowing horde, and the dancing turrets raced madly to keep up their program. They lost space, and the wall of coruscating death moved inward.

From long range the *Pleiad* opened fire, and the dancing motes

(*Continued on page 155*)

Spectrum
of
Generators

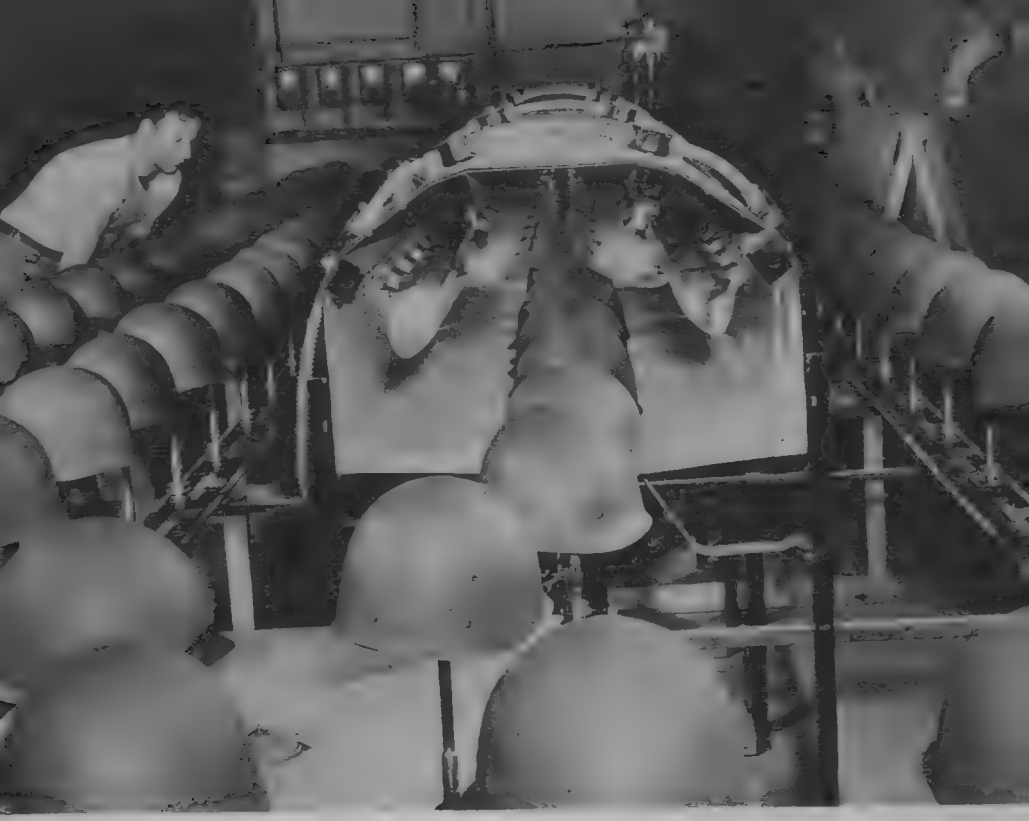


On these pages is a variety of gadgets, devices, and hookups intended to generate electromagnetic energy. The assemblage is not complete; some of the equipment available in fact cannot be photographed. That "cannot" is used both literally and in the colloquial sense. We can't photograph an atom, and we may not print photographs of some of the more modern gadgetry developed in the last few years.

All of these devices are, essentially, de-rectifiers; they take in direct current—electrostatic potential energy—and convert it to alternating currents of almost any frequency in the spectrum.

Starting on page 99 is the lowest end of the spectrum—the power-line alternating current frequency—generator. This is actually used more often as a rectifier for converting the standard 60-cycle AC power to DC than vice versa, but it can be, and has been, used both ways.

The mercury-vapor arc type of generator such as that on page 99 works well up to about the top end



of the audio-frequency spectrum—which is the bottom end of the radio-frequency spectrum, the frequencies used in the longest of long-wave wireless work. The wave-form it generates is not pretty, however; instead of being smoothly contoured sine waves, it's more like a profile drawing of the end of a pile of lumber.

For applications requiring less brutal power-handling capacity and a bit more finesse on the wave-form, and to reach higher frequencies, the grid-controlled vacuum tube is used. The standard radio broadcasting station depends on them, of course—as does the most common type of household receiver. The usual home set is a small superhetrodyne, incorporating an oscillator tube which converts the DC supply from the set's rectifier into AC at anything from above one million to twenty-five million cycles per second.

The grid-controlled vacuum tube can go from zero cycles straight out to about 2,000 million cycles fairly handily. (Not, be it noted, any of the familiar tube types, how-

ever. About two hundred, not two thousand megacycles, is the limit of the ordinary types.) Still higher frequencies can be generated in vacuum tubes of decidedly unorthodox design, but all vacuum tubes fall off helplessly far below the lowest depths of the infrared or heat-radiation range.

There's a crossover device—a method for generating radiation short enough to be detected by heat-measuring devices such as the bolometer, and yet long enough to be detected by radio-detection methods. Far from being a vacuum tube, it's an oil-filled tube, startlingly similar to the apparatus radio started with. It's full of oil and metal filings; sparks between the metal filings, generated when high potentials are applied across the tube, gen-

SPECTRUM OF GENERATORS

erate the ultra-frequencies. Sorry —for that one, we couldn't find a photograph.

Next up the spectrum is the infrared range proper. That is ubiquitously, irritatingly easy to generate usually to the intense annoyance of the engineer. Of course, at times it's just what is wanted—sunbowl heaters, for instance. That then represents the engineer's perfect job; he gets perfect, one hundred percent efficiency for the first, last and only time, and does it without trying.

But usually you want, even when you want heat, a more specific type of heat. The infrared lamps used in the baking tunnel shown on page 101 are designed to convert the maximum possible percentage of input energy into the reflectable, effective baking range of wave lengths; and to heat the desired object—helmet liners—as much, and the air as little as possible.

Until the last few years, a modified type of heat lamp, known as the incandescent lamp, was about the only way of turning electrical energy into the still shorter wave lengths of visible light. As a heat lamp it, too, was highly efficient—matter of fact, if you considered it as a heat-radiation generator, it "wasted" only some two to five percent of its input as light. As a light-source—it was still a darned good heat lamp.

More recently, the fluorescent lamp has been developed; but for the war, it would be far more common now, familiar as it has become despite that handicap. It generates the light frequencies by a far more sensible, efficient method. It directly applies the electrical energy to excite gaseous atoms, generating the natural spectrum response of the gas—mainly mercury-argon. The spectrum of the gases picked is extremely rich in the ultraviolet, and this high-level energy is "stepped down" by fluorescent compounds to the desired visible light frequency.

Ultra-violet itself has uses, of course. The gas arc, or gas discharge tube is the handiest way of generating it, but "ultraviolet" is a term somewhat like "up"—it means simply "beyond the violet."

How high is up? And what are the properties up there?

A certain part of the ultraviolet causes tanning in human skin. It's also highly effective in photochemical reactions, and used for blueprints and photography. Another range is highly useful in night-fighter planes, because of its property of causing fluorescence. The pilot must not be exposed to visible light lest he lose the extremely sensitive night vision available to dark-adapted eyes. Ultraviolet lights cause fluorescent instruments to light up—but, unlike radium dial equipment, they can be turned off when necessary. Then there's the region of the ultraviolet, just a bit beyond the visible, that is a real, no-holds-barred death ray. The sterilizing radiations of that region, generated by a small, cheap gas tube, are simple, sudden, and violent death to microscopic life forms. That's another contrivance the war has delayed; it will be more familiar soon. It will sterilize a shoe as thoroughly as live steam, but with a lot less damage.

The X-ray region and beyond, however, is the region of modern exploration. There's one shot of X-ray tubes, on page 105, but it is inadequate, incomplete, and simply a note that "this is one general method." X-ray tubes vary as widely as incandescent lamps—so far as size, power, and intended function goes. What the dentist needs to snapshoot a toothache is rather different from the remote cousin that the roentgenologist uses to shoot and kill cancer's ache. And finding cavities in human teeth takes a lot less penetrating radiation than finding cavities in 18-inch steel armor plate.

And finally there's the hard-radiation generator, the X-ray generator, that we can't photograph. The atom, made to order. Out of raw ores, sand, and ingenuity man has learned to carve the filament, cathode, and anode of radio tubes and X-ray tubes.

Out of the raw, naturally existent atoms, we've learned now to shape new, synthetic atoms that will generate the radiation we want, for the length of time we want, and at the intensity we want. There's a cancer of the blood—leukemia—that X rays can't touch, because you can't concentrate the radiation on the blood. You're bound to hit the solid tissue, which stands still, more and harder than the blood. But not if you can mount your X-ray generator in a molecule and slip it into the bloodstream itself. You'll still be hitting the normal tissues, but no more, now, than the cancerous cells.

Synthetic radio-sodium has been used for that, with signs of real success. There's another synthetic atomic generator that will trim an overgrown thyroid more neatly, more accurately, than any surgeon's knife, too.

Sorry—no pictures of that, either. Not yet, anyway.

THE END.

The Perfect Machine

by A. BERTRAM CHANDLER

An officer of the British Merchant Navy feels the magnetic compass is the Perfect Machine. May be so—may be so. It's simple, but its use — —?

It has been said, probably by more than one person, that those machines nearest to perfection are those that have the fewest moving parts. At sea it is usual to award the palm to the steam turbine; certainly, compared with either the reciprocating engine or the Diesel motor, it stands alone in its essential simplicity.

But it is not until the mariner has been exposed to education at one of the courses run by the manufacturers of gyrocompasses that he begins to look upon that old friend of man, the magnetic compass, as a machine. And, as a machine, it comes near to satisfying the requirements stated in the first sentence.

One is struck by the vast number of moving parts in the gyrocompass, sensitive elements, phantom elements, motors running on A.C., motors running on D.C., and even, in the later models, amplifiers for the transmission system.

And then there's our old friend the magnetic compass, doing its stuff night and day entirely independent of any external power supply, the instrument that guided the early Chinese navigators to California and, possibly, the Cape of Good Hope, that led Columbus west, and ever west, to the New World, the

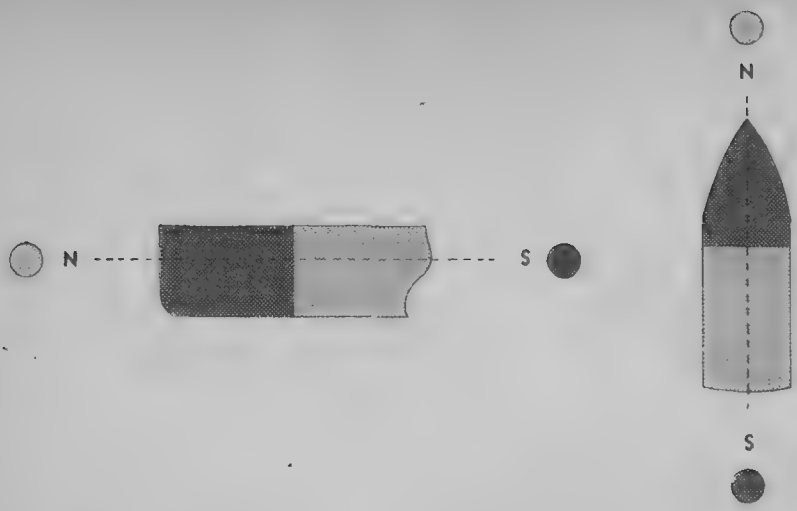


Fig. 1. Right: Earth's lines of force run fore-and-aft, making ship a symmetrical bar magnet. Left: On Magnetic Equator, lines of force are horizontal, hence ship is also a symmetrical bar magnet from this aspect.

faithful companion of Cook, Drake, Magellan, Dampier—the list could be continued almost indefinitely.

Unfortunately, before this friend of man is a true friend, it has to be understood. Thoroughly. Oh, if you are lucky, you can go through life regarding it with the superstitious awe with which so many captains and officers do regard it, you can leave its adjustment to the professional adjusters who, efficient though they so often are, do not know *your* ship as you do, and at the most it will cause you no more than a few moments of annoyance and inconvenience. On the other hand, it may land you in the soup with a loud and resounding splash. Perfect though it is in so many respects, the magnetic compass is the plaything of forces which, by many, are but imperfectly grasped. In fact, when the author was taking his gyrocompass course, during the tour of the factory which is part of the instruction one of the other officers remarked, "Just think of it! This place is no more than one big monument to the inability of the average sea officer to grasp the fundamentals of terrestrial magnetism!"

The first, and most easily understood, error of the magnetic compass is that caused by variation, as we call it. The scientists call it Magnetic Declination, but since the navigator has to deal with another kind of declination, that of the

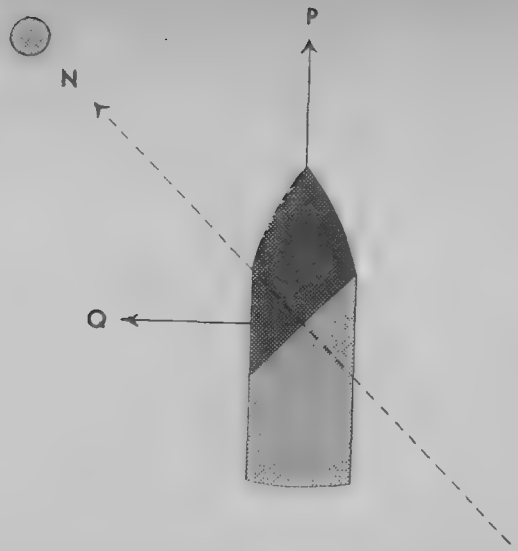


Fig. 2. Ship built heading northeast. Force P is seen acting in a fore-and-aft direction. Force Q athwartships.

heavenly bodies, he prefers a distinctive label.

Not much space need be devoted to variation. Everybody knows, or should know, that the Geographical and Magnetic Poles do not coincide. Consequently, in different parts of the world one's compass needle makes a different angle with the True Meridian. Charts, called Variation Charts, are published at frequent intervals, and from these the mariner can obtain the necessary correction to apply to his compass courses in any part of the world.

For some reason, possibly due to movements of the Earth's stress-fluid, nickel-iron core relative to the crust, the Variation is always changing. For example, Agulhas—"Needle"—Point, on the South African coast was so named by the Portuguese because in its vicinity the True and Magnetic Meridians coincided. Today, the Variation is in the neighborhood of 30° West. Two hundred and sixty years ago the Variation at Glasgow was Nil, now it is 18° West.

It wasn't long, historically speaking, before the early navigators compiled quite reliable Variation Charts. In their wooden ships, with their compasses not exposed to the forces to which ours are, they had every opportunity for so doing. It took them longer, however, to discover that Variation was not a static quality.

As late as 1676 a certain Henry

Bond invented a most ingenious method of obtaining position at sea by careful observations of the Variation and the Magnetic Dip, the angle from the horizontal by a freely suspended compass needle. Had Variation and Dip been constant qualities, it might have worked.

So, for many years, the world's sailors sailed the seas in their wooden ships, secure in the knowledge that, of all their instruments, the magnetic compass was the most reliable.

Then, along came progress, in the shape of the first iron ships, and things went generally haywire. The tried and trusted friend of generations of navigators became as fickle as the proverbial girl friend of the proverbial sailor with the girl in every port. You know the one I mean, the one with the sailor in every ship.

The trouble, of course, was obviously due to the fact that an iron ship is a collection of magnets. Worse still, she is a collection of all kinds of magnets, permanent, semi-permanent, and induced. The building direction, too, is of great importance.

What was required was the production of a set of rules by which the mariner could correct and adjust his compass for the errors, or Deviations, involved.

So it was that in 1855 a body of scientists, known as the Liverpool

Fig. 3. Ship built in high North Magnetic Latitudes. Force R is seen acting downwards; there is a Blue Pole under the compass, making the use of Heeling Error magnets, Red end up, necessary to offset this.

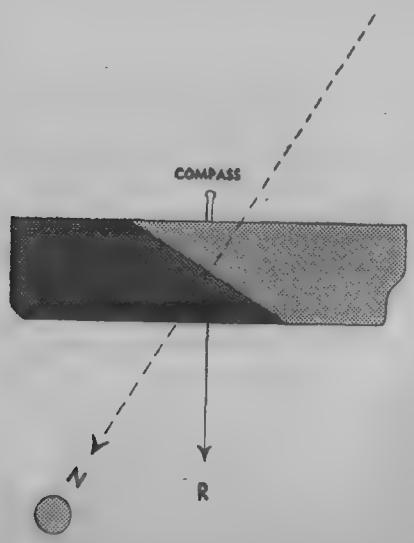


Fig. 4. Ship built heading northeast is shown steering South. The Red Permanent Magnetism to port repels the Red, North-seeking end of the compass needle, causing westerly deviations. You'll never get home that way!

Compass Committee, was set up, and by its work made all the errors that the magnetic compass is heir to more or less comprehensible to the navigator.

When a ship is being built she is subject to a severe and constant hammering during the process of riveting. A bar of hard iron put in line with the Earth's lines of force and hammered over a long period will become a permanent magnet. So it is with the vessel's shell plating. This magnetism, by the way, could, perhaps, be called "semipermanent." But it fades so slowly that, at the end of a ship's life, there is still some of it there.

(The author, by the way, would be very grateful if any reader has data on the magnetic condition of all-welded ships.)

Figure 1 shows a vessel built under absolutely ideal conditions, heading Magnetic North right on the Magnetic Equator. She becomes a plain, straightforward bar magnet, her bows receive Red, or North-seeking magnetism, her stern Blue, or South-seeking.*

Regarding Permanent Magnetism, she is a compass adjuster's dream of Paradise.

Unfortunately, in this respect shipbuilders are notoriously uncooperative. There may be yards bang on the Magnetic Equator, there may be ways running North-South Magnetic. But if there are, I have never heard of them.

On the Clyde, for example, the lines of magnetic force make an angle of no less than 70° with the horizontal.

This brings us to the condition that I have tried to picture in Figures 2 and 3. It really needs a three-dimensional model to do justice to the involved state of affairs.

At this stage the Liverpool Compass Committee brought another old friend of Man to their aid, the well-known parallelogram of forces. With its aid, the forces playing "here we go round the mulberry bush" with the compass were re-

* Sorry—three-color printing on this isn't practicable. The Benday screening has to represent the mariners traditional magnet colorings. They use colors in referring to magnet poles for the excellent reason that since the so-called "North-magnetic" pole of a compass goes toward the north, the Earth's *south* magnetic pole is near the *north* geographic pole. Color-names avoid this confusion—worse—confounded!

solved into three components, P (or fore-and-aft), Q (or athwartships) and R (vertical).

Our demonstration ship was built heading northeast Magnetic. Therefore, as can be seen, she will have Red magnetism forward, Blue aft; and a preponderance of Red to port, Blue to Starboard.

Regarding R, with the compass in its usual place, a little forward of amidships, we have Blue exercising its attractive influence bang under the North-seeking end of our needle.

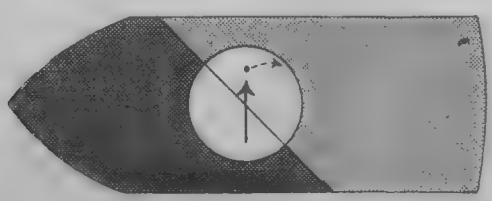
Our demonstration vessel is launched. But before she can put to sea there is a ceremony to perform of far greater importance than that of bathing her beautiful bows with champagne. She is initiated early in life into the ways of this wicked world. She learns to expect some hard knocks, literally. She is taken by heartless tugs and battered against a hard quay wall. This ensures that any not-quite permanent magnetism is shaken out. Otherwise it would fade during the course of the voyage, fast enough to mean that compasses correct on sailing from the Royal Albert Dock would be hopelessly out on arrival at Wellington.

By some regrettable oversight, our hypothetical vessel sails with unadjusted compasses. This, of course, would never happen in real life.

The good ship *Guinea Pig* is sailing gaily south. All is going very smoothly until the Officer of the Watch, one of those irritating young men who just can't leave well enough alone, decides that the captain would, perhaps, appreciate a few compass errors. (The Error, by the way, is the sum of the Variation and the Deviation, this latter being the result of the ship's magnetism.) The sky clears, the sun shines, and having obtained a compass bearing of same Mr. Ben Bowline gets to work with Nautical Almanac, Azimuth Tables, et cetera.

He finds, to his horror, a really colossal Westerly error. The Westerly Variation, which was allowed for when the course was set, has been augmented more than somewhat by a real, hearty dollop of

Fig. 5. Ship built heading northeast steering West. The Red Permanent Magnetism forward causes easterly deviation.



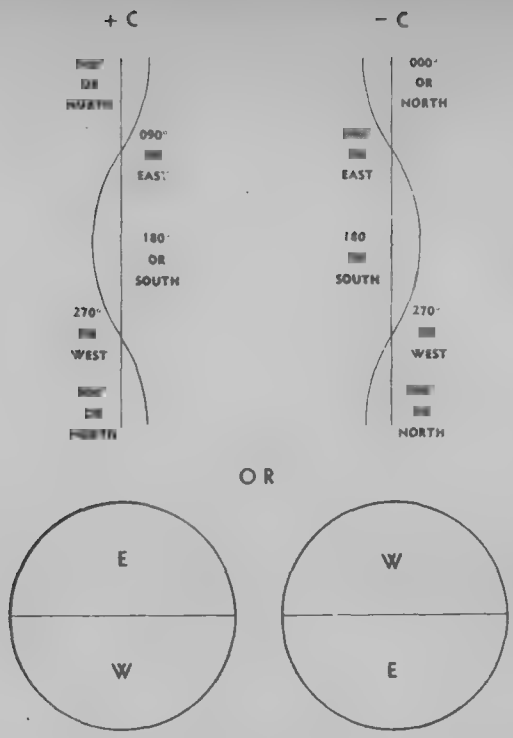


Fig. 6. "C" is maximum on North and South, nil on East and West.

Westerly Deviation.

The cause?

Just look at Figure 4. The preponderating Red on the port side of the compass has pulled the Blue, South-seeking end of the needle, and has given the Red, North-seeking end a hearty nudge to the West'ard. Or, if you like, you can say that the preponderating Blue has done just the reverse.

All of this means that *Guinea Pig* is miles to port of her course, so far off her course, in fact, as to be in imminent danger of piling up on the cruel rocks barely showing their ugly, black fangs above the surface of the storm-tossed ocean.

But our hero sees them just in time. Bellowing "Hard a Starboard!" to the quartermaster, he frantically rings "Stop!" on the starboard engine-room telegraph, thereby frightening the engineer of the watch, an inoffensive youth peacefully washing his socks in a quiet corner by the condenser, out of a year's growth.

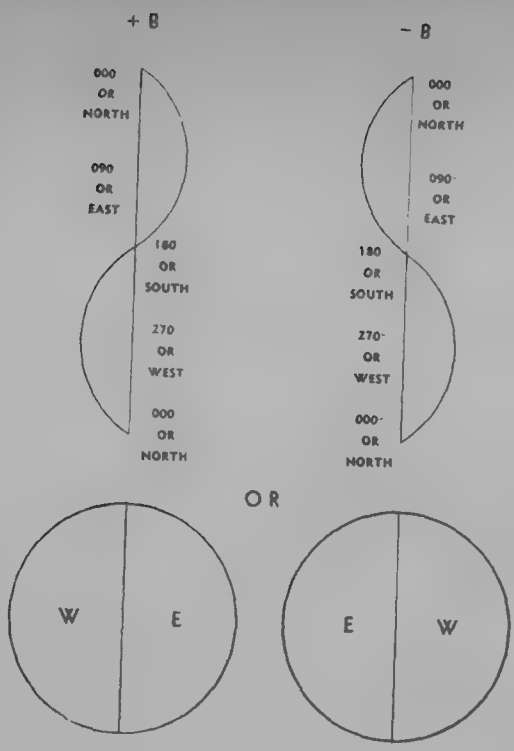


Fig. 6a. "B" is maximum on East and West, nil on North and South.

The Old Man, having had all this excitement happen in the middle of his morning coffee, takes a poor view of things, and of his watch officer. But he is soon convinced that Mr. Bowline acted for the best, and decides to investigate the somewhat chaotic magnetic condition of his vessel still further.

By this time, the ship's head is steady on West. Another azimuth is taken. The result: Easterly Deviation. Figure 5 shows why. The preponderating Blue abaft the binnacle has pulled the North-seeking end of the needle to the Eastward.

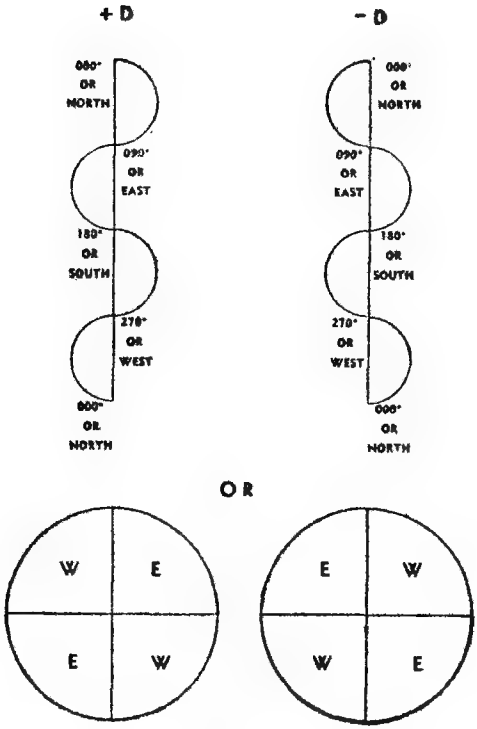
All the above, naturally, has caused its measure of alarm and despondency. This the Old Man attempts to dispel by the performance of the mystic rites known as "swinging the ship." The bar magnets are brought up from the captain's cabin, Mr. Bowline, the Third Officer, looks on in awe, the chief

and second officers mutter to each other, each perfectly confident that he could do the job *so* much better.

The sky is now overcast once more, but that doesn't worry anyone. The rocks, on which we almost piled up, are still visible. The mean of four bearings, taken on North, East, South and West will give us the Magnetic bearing. The difference between Compass and Magnetic will, of course, give us the Deviation.

On North, there is Easterly deviation. On South, it will be Westerly. Reverse the sign of the deviation on South, and the two, halve, and the result is "Coefficient C." In this case, Plus "C." It is a semicircular deviation, varying as the cosine of the course. Figure 6 shows two ways of expressing it diagrammatically. Minus "C," of course, gives Westerly deviation on

Fig. 6b. "D" is maximum on the quadrantal points, nil on North, South, East and West.



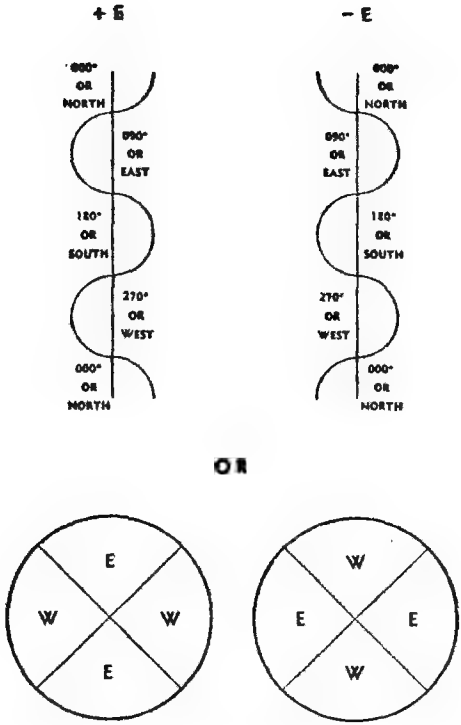


Fig. 6c. "E" is maximum on the cardinal points, nil on the quadrantals.

North, and is the result of the ship's head being South Westerly when building.

The correction of Coefficient C is simple—in theory. All you have to do is to steady the ship's head on North, then put athwartship magnets in the pigeonholes of the binnacle until the Red end of the compass needle is pushed and pulled back the right amount. In this case, the magnets are placed with their Blue ends to port. Get the idea? Small magnets placed close to the compass have set up a field of force equal and opposite to that produced by the ship.

In the meantime, somebody has worked out Coefficient B. With a certain diffidence it is handed to the captain, the lightning calculator pointing out that, as the ship's head was exactly North 45° East in the building yard, B should equal C. Pythagoras and all that, you know, sir.

He is told that these things are all very well in theory, but that we are practical men. So the com-

pass is corrected for B, in this case a Minus B. As will be seen from Figure 6a, it is a sine curve, the deviation varying as the sine of the course. It is obtained by halving the sum of the deviation on East and West.

Then they swing the ship again. On North, deviation Zero. East, West and South, ditto. Then, just for the hell of it, somebody suggests that they see what the results are on Northeast, Southeast, Southwest and Northwest.

There are results. The soft iron running athwartships acquires its maximum induced magnetism with the ship's head on East or West, Magnetic. But then, of course, the lines of force from these induced magnets will be in line with the lines of force of the Earth. Result; no Deviation. When the ship's head is North or South, these soft iron bars are running at right angles to the Earth's lines of force. Result: once again, no Deviation.

But steer at an angle of 45° from the Magnetic Meridian, and then you have the maximum effect. Coefficient D, it is called, and is a sine curve, varying as the sine of twice the course. Plus D is the most usual condition, but under certain very exceptional circumstances, a Minus D may be found.

However, *Guinea Pig* is a vessel of orthodox construction and her compasses are corrected in the orthodox manner. D *could* be taken out with some arrangement of permanent bar magnets, but this is *never* done in practice. "Like cures like" is the golden rule of compass adjusting. And so the Quadrantal Error is compensated by means of the soft iron correctors, familiarly known as Lord Kelvin's Balls.

Those readers who have been aboard ship will remember them, those two spheres, one on either side of the binnacle.

The story goes that in one liner, passengers being taken on a conducted tour of the bridge would be asked, "How do you know this is a mail boat?" Many wild guesses were hazarded, until, at last, the guide would take mercy on his charges and point, mutely, to the soft iron spheres, one on either side of the binnacle.

These spheres, by the way, are hollow. They are just as effective as they would be if solid, and, certainly, far less heavy. When a hollow, soft iron object is placed in their path, magnetic lines of force flow through and around the shell, becoming, of course, far more concentrated. The empty space inside is, therefore, quite effectively shielded from any external field of force. That is why the gyrocompass was invented, for the benefit of submariners whose compasses just refused to behave.

With the ship's head on Northeast—it could be any of the other three courses 45° from the Magnetic Meridian—the soft iron correctors are shifted in and out on their frame. At last the compasses are corrected. One more swing, and there appears to be no deviation worth talking about on any heading. Coefficient A, due to an

incorrectly marked card or a lubber line not placed in line with the fore and aft line of the vessel, does not appear. Neither does E, a real dastard. This is similar to D, but is a cosine curve and is caused by unsymmetrical distribution of soft iron. Aircraft carriers and similarly lopsided vessels may be afflicted by it, but the average ship, never; unless, that is, her bridge is cluttered up with ammunition lockers, sanitary and fresh water gravity tanks, et cetera, placed with a fine disregard for the feelings of the compass.

All is not yet well, however. As *Guinea Pig* proceeds on her way rejoicing, a fresh fly rears its ugly head from the ointment. And the name of this bug? Heeling Error.

You will remember that a force known as R was mentioned quite a while back. Well, this is it. A beam swell has risen, the good ship is rolling easily, and the compass card seems determined to achieve at least one complete circle without an alteration of course. Matters are hardly improved by the conscientious, but not too intelligent, helmsman, who is doing his best to follow the swinging compass.

Owing to the Magnetic Latitude in which the ship was built, there is a nice, permanent, Blue pole under our binnacle. The ship is on a Southerly course. As she heels to port, the compass bowl, slung in gimbals, remains horizontal; but this Blue pole comes up to starboard of it, attracting the Red end of the needle to port. When the ship heels to starboard, the reverse takes place.

The cure is simple. Directly under the compass bowl, in the binnacle, is a well. Suspended on a chain in this well is a bucket. (The words are used quite literally.) And in this bucket are placed permanent bar magnets, in this case Red end up. The bucket is raised or lowered as required.

Perhaps I have erred on the side of over-simplification. Obviously, in high magnetic latitudes, there will be a considerable induced polarity in the vertical soft iron under the bridge. This, too, will contribute to heeling error. And then, when the vessel is rolling, there is the effect of the thwartship beams tending to come into the vertical.

When the Magnetic Equator is reached, the effect on vertical soft iron—frames, et cetera—is annulled. Then, many unimaginative navigators, whose buckets have reached the bottom of their wells, reverse their heeling error magnets; but the permanent vertical force of the ship should be taken into consideration. Actually, for a ship built in the Northern Hemisphere, the magnets should be reversed a little—or a lot, depending upon the magnetic condition—South of the Equator.

Of course, there is always one safe and sure method of determining the correct polarity and position of your heeling error magnets. That is the Vertical Force Instrument, which is, essentially, a compass needle free to turn around a horizontal axis. The compass is re-

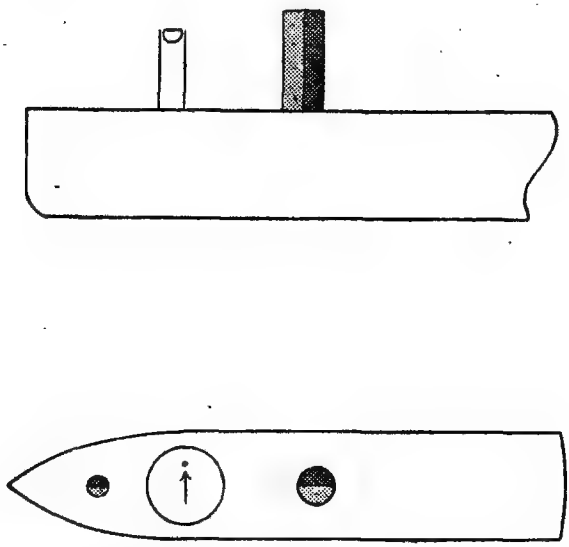
moved from the binnacle and the Vertical Force Instrument hung in its place, so suspended that the needle is in line with the Magnetic Meridian. Should the Red end be forced upward, that is a sure sign that there is a Red pole exercising its repellent influence below the compass. The bucket and its magnets can then be adjusted as required till the needle is horizontal.

I once sailed with a very scientific second officer who was always playing around with this instrument. One of his hobbies was comparing the vertical force experienced aboard ship with that ashore, and both with the official admiralty charts. He had prevailed upon the carpenter to make him a special tripod from which his beloved gadget could be suspended when used on the beach.

In port, when circumstances permitted, he and one of the juniors would sally ashore with all the paraphernalia, select a suitable spot free from magnetic influence—cranes, corrugated iron warehouses, et cetera—and take observations.

Once, in Capetown, not long before the outbreak of the present unpleasantness, they were doing their stuff on a piece of waste, reclaimed ground not far from the ship. Quite a few idlers gathered to

Fig. 7. Top: Ship steering South on Magnetic Equator. Bottom: Ship steering West on Magnetic Equator. The Earth's lines of force are horizontal, the induced magnetism in the vertical soft iron has no effect.



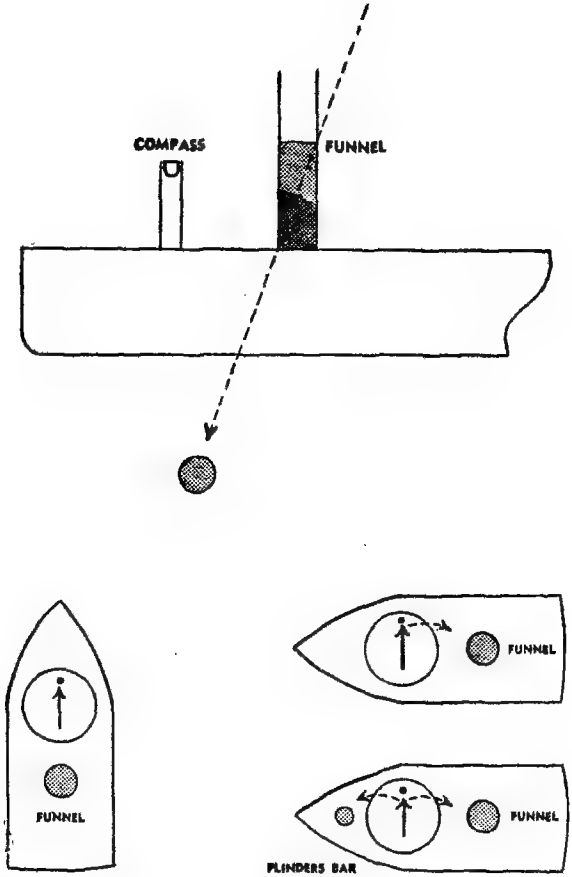


Fig 7a. Top: Ship in high North Magnetic Latitudes. Induced magnetism in funnel gives Blue Pole abaft compass. Bottom Left: Steering North, no effect. Middle Right: Steering West: Bottom Right: "B" removed.

watch in wonderment. Finally one, to whom a uniform was just a uniform and to whom they could have been among those placed in high authority instead of Officers of the Merchant Navy, diffidently asked what they were doing. MacFarren put on his best hush-hush expression. "A. R. P." he whispered. "Oh, I *see,*" replied the bystander, in an equally low voice, and departed with the air of one about to tell his pub mates all about it.

But we have deserted *Guinea Pig* and her devoted crew. They, too,

have arrived on the Magnetic Equator. On their way they have noticed that their Napier's Diagram—a Deviation Curve which is the resultant of Coefficients B, C, D and E—if any—has failed to hold good for Easterly and Westerly courses. So, just to do the orthodox thing, they swing ship again in Magnetic Latitude Zero.

Lo and behold! Coefficient B now equals Coefficient C. So it should, anyhow. It should have done so from the very start, provided that the effect of vertical soft iron on a level with the bridge and compasses had been compensated.

In any ship of normal construction you find a preponderance of vertical soft iron abaft the bridge. Forward of the compass there is, as a rule, just one mast. Aft, you have the funnel—and don't forget what lines of force do when they encounter hollow, soft iron shells—and another mast. So, in Northern latitudes there is one induced bar magnet, Blue end up, forward, and two, with the same polarity, aft.

With the ship's head North or South, all these poles *and* the Earth's poles are in line. No effect is felt, unless it be a certain strengthening of the Horizontal Force. On East, those two Blue poles abaft the binnacle are having a tug of war with the one Blue pole forward. And winning. The Red end of our compass needles are pulled aft.

The obvious thing to do is to bring up reinforcements for the weak, Blue pole forward. This is done by means of what is called the Flinders Bar, which really isn't a bar but a collection of disks of soft iron. They act as a bar, however. They live in a brass, cylindrical case mounted just forward of the compass. The bar can be raised or lowered, lengthened or shortened, by juggling with disks of wood of the same size.

As will be seen from the figure, when the Vertical Force is zero, as on the Magnetic Equator, the vertical soft iron of masts, funnel, *and* Flinders Bar will have no effect. Therefore, if compasses are corrected in Magnetic Latitude Nought, any error that creeps in in higher latitudes *must* be due to vertical soft iron, and can be taken out by juggling with the Flinders Bar.

Of course, the Flinders Bar needn't be forward of the compass. It may have to be aft, if there is a preponderance of vertical soft iron for'ard.

I have served in one ship which possessed, for her steering compass, no less than two Flinders Bars. Even these weren't sufficient, and somebody had rigged two allegedly soft iron rods alongside them to help them out. The arrangement seemed to work perfectly well in the Northern Hemisphere, but in South latitudes the compass acquired a really hefty coefficient B. I tried hard to figure out where the Big Blue Pole forward, or the Big Red Pole aft, could possibly be. At last I found it. Thanks to a long sojourn in home waters, the not-so-soft iron rods had become more or less permanent magnets,

and in South latitudes were performing exactly the reverse of their proper function. All of which points to the moral that "know your own ship" is one of the primary rules of compass adjusting.

I have in mind another little story on the same theme. There is an ingenious instrument called the Deviascope. It is, in effect, a model ship, so mounted as to be capable of being swung around its vertical axis. It can also be heeled to either port or starboard. Cut in its deck are grooves for every point of the compass, and, by inserting bar magnets in these it is possible to simulate any permanent magnetic condition due to building direction. It has two soft-iron bars running athwartships under the compass to give the effect of beams, et cetera, and also a vertical post of soft iron abaft the compass. The compass itself is complete with Lord Kelvin's Balls and Flinders Bar. As this latter *is* a solid bar, it can't be lengthened or shortened, but the effect is obtained by moving it closer to or further from the compass. Finally, to simulate force R, there is a socket directly under the compass in which a permanent bar magnet can be placed, and another one, just above it, for the Heeling Error correcting magnet.

The instrument is used both by instructors and examiners.

When I was sitting for master, another officer and myself had our Orals on the same day. Both of us had done excellent magnetism papers—all the questions had been on things that we knew something about—so we were given a free hand with the Deviascope.

Whilst one was being grilled on seamanship and Shipmaster's Business in the Seamanship Room, the other was left to his own devices in the Compass Room.

In my case, I was just told "Build your ship heading Northeast by North, and correct her any way you like. I'll be down in an hour's time to see how you've got on."

Well, I built my ship as required, and then decided that time permitted a nice, leisurely Analysis Method. All very scientific and all that, and interesting to do. Using a water pipe in the corner of the room as my fixed point, I got to work with the sight vanes. The mean of all the bearings, of course, gave me my magnetic bearing.

There was Coefficient A, hardly surprising, as both the Deviascope and its compass were of strange design and immemorial antiquity. Anyhow, there was nothing I could do about that. There were, of course, B, C, and D, and also a small E, which, I decided, shouldn't be there so could safely be ignored.

One by one, the coefficients were liquidated.

Once more I swung ship. The result was excellent.

Last of all, Heeling Error.

I put the ship's head on North, gave her a 45° list to starboard.

There was considerable deviation, even more than there should have been, as the fore-and-aft magnets

to port slid inboard and those to starboard slid over the side.

Once again, B was dealt with, and, this time, the magnets were wedged with scraps of paper.

And then, I was finished. Leaving well enough alone, I awaited confidently the advent of the examiner.

He came; he swung the ship; he obtained simply colossal deviations on every heading. He told me to check his findings. I did so, and told myself, "This is where you get thrown out!"

He checked my workings. They, thank Heaven, were correct.

At last, just as I was going to mention Gremlins, he asked, "When *did* you correct for Heeling Error?"

"Last of all, sir!"

"Ah!"

He removed the magnets which were simultaneously correcting heeling error and introducing all sorts of private ones of their own. He swung ship once more. On all headings; Deviation Zero.

It's a good job I went up the week they passed people.

But once again we have deserted our experimental ship.

She is steaming gaily South and West from Panama to the Fiji Islands, where she has a small parcel of cargo to discharge at Suva. Talking of cargo, I have been kind-hearted and haven't filled them up with a load of assorted ironmongery which will add to their magnetic troubles. In fact, their magnetic troubles appear to be over.

From Suva, she carries on to

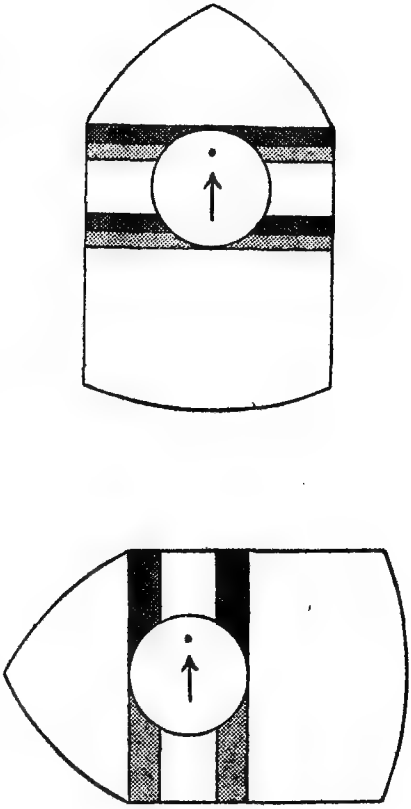


Fig. 8. Top: Ship steering North. No effect. Bottom: Ship steering East or West. Everything is in line. No effect. Not just now—at least!

Wellington. The course has been laid off to bring her down the West Coast of the North Island, so as to approach the port by way of Cook Strait.

It is mucky weather when she turns the corner. Not so good, coming through the Straits, where all kinds of currents may be ex-

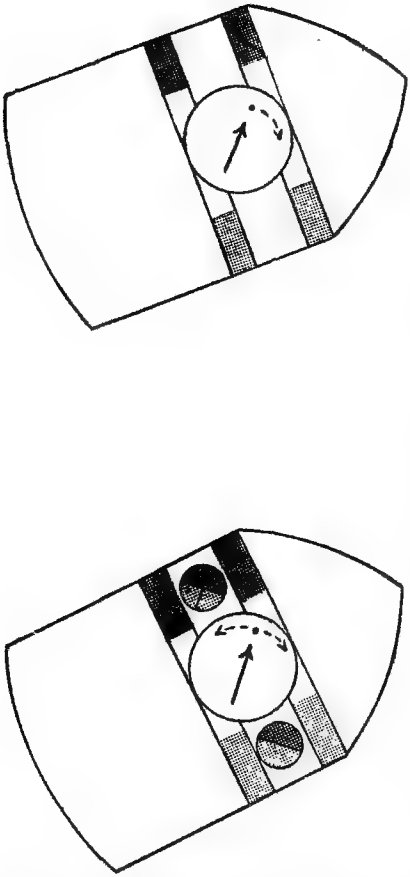


Fig. 8a. Top: Ship making an angle of 45° with Magnetic Meridian. Maximum effect. Bottom: Same ship. Soft iron spheres give effect of divided soft iron beam, cancel effect of continuous metallic beams.

pected. Nobody is surprised when, through the driving rain, breakers are sighted. Immediate action is taken, but it is too late. On her maiden voyage, *Guinea Pig* becomes a total loss. The most subtle and insidious error to which the magnetic compass is heir has found another victim.

Its name is Gaussin Error. The physicist after whom it is named is also remembered in the Gauss, which is the unit of magnetic force, and also in the word "degaussing." This latter is a theme on which I would dearly love to enlarge, but it's all very hush-hush just now.

Guinea Pig has been on a southerly course from Fiji to New Zealand. Her soft iron has acquired induced polarity, Blue forward, Red aft. But some of her soft iron could be classed as intermediate. And when she swings to her new course through the Straits, some of the induced magnetism lingers for an appreciable time.

We will say that the course through the Straits is S 60° E, True. Variation, from the chart, is 15° E. Deviation is Zero. That makes the compass course S 75° E. But there's that residual Blue forward, pulling at the Red end of the compass needle, there's that Red aft tugging at the Blue end. The weather is dirty, there has been no opportunity to check the error by means of astronomical observation. The Deviation *should* be Zero.

It is, actually, 5°—shall we say—East. Error, therefore, 20° East. Compass Course: S 75° E. True Course: S 55° E. Just five degrees out, on a clear night a matter to be easily rectified, but on a dirty night an error that may prove fatal.

By this time the reader will be saying, "And if this be the Perfect

Machine, then God save us all from the imperfect ones!"

Perhaps, perhaps.

But bear in mind that, in using any perfect machine we are up against one of the most imperfect, the well-known human race. Given a little care and understanding, the magnetic compass will give years of service as faithful and reliable, perhaps, at times, more so, as its expensive and complicated mechanical successor.

So, reader, if ever you have intimate dealings with the ancient lodestone, remember the most deadly of all the coefficients, coefficient X. It may reside within yourself.

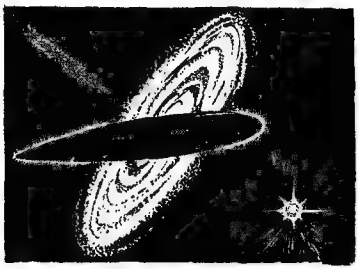
THE END.

Author's Note.

At last I typed the magic words: "The End." Before I could remove the paper from the machine the Fourth Officer, sent down from the Bridge, informed me that I had made a mistake of ten degrees in applying the error to a course ordered by the Commodore.

And I had handed over the watch complaining bitterly that none of the other ships were steering a decent course!

Coefficient X.



HE GOT THE PURPLE HEART.

WILL A BOND PROVE TOO COSTLY FOR YOU?

It's left to your own conscience, because that's the kind of country we are. Somewhere else in the world, the money needed to carry on the war would be gotten through added taxes, compulsory savings. But not here. Because we're still free . . . and it's still up to you—and no one else—to decide whether or not your country, or your boy, is worth another bond.

BUY IT NOW!
THE WORLD'S
BEST INVESTMENT!

WAR BONDS

The Waveries

by FREDRIC BROWN

They were invaders, of a sort. They didn't hurt—couldn't hurt—a fly, let alone a man. But they could and did destroy a culture—!

Illustrated by Orban

Definitions from school-abridged Webster-Hamlin Dictionary, 1988 edition:

wavery (WĀ-ver-ĭ) *n.* a vader—*slang*

vader (VĀ-dĕr) *n.* inorgan of the class Radio

inorgan (ĭn-ÔR-găn) *n.* noncorporeal ens, a vader

radio (RĀ-dĭ-ōh, ră-DĒ-ōh) *n.* 1. Class of inorgans 2. Etheric frequency between light and electricity 3. (obsolete) Method of communication used up to 1947.

The opening guns of invasion were not at all loud, although they were heard by many people. George Bailey was one of the many; I choose George Bailey because he was the only one who came within a googol of light-years of guessing what they were.

George Bailey was drunk and under the circumstances one can't blame him. He was listening to radio advertisements of the most

verbose and annoying kind. Not because he *wanted* to listen to them, but because he'd been told to listen by his boss, J. R. McGee of the MID network.

George Bailey wrote advertising for the radio. The only thing he hated worse than advertising was radio. And here, on his own time in the late evening, he was listening to fulsome and saccharine drippings on a rival network, at J. R. McGee's suggestion—which George very rightly took for an order.

"Bailey, you should be more familiar with what others are doing. Particularly those of our own accounts which use several networks. I'd suggest that—"

One doesn't quarrel with suggestions and keep a hundred-and-fifty-dollar-a-week job. But one can drink whiskey sours while listening. One George Bailey did.

Also, one could play gin rummy with Maisie Hetterman, a cute little red-headed typist from the studio. One could do no more than that, but Maisie was worth just looking at across a card table. It was Maisie's apartment and Maisie's radio, but George had brought the liquor.

"—only the best tobaccos," said the radio, "go *dit-dit-dit*—the nation's favorite cigarettes—"

George glanced at the radio. "Marconi," he said.

He meant Morse, naturally, but the whiskey sours had muddled him a bit, so he was nearer right than most people who heard that *dit-dit-dit*. It *was* Marconi, in a way; in, as it turned out, a very peculiar way.

"Marconi?" asked Maisie.

George Bailey, who hated to talk while a radio was going, leaned over and switched it off.

"I mean Morse," he said. "Morse, as in Boy Scouts or the Signal Corps. I used to be a Boy Scout once."

"You don't look it."

George sighed. "Somebody going to catch hell," he said, "broadcasting code on that wave length."

"What did it mean?"

"Mean? Oh, you mean what did it mean. Uh . . . S, letter S. *Dit-dit-dit*. SOS is *dit-dit-dit dah-dah-dah dit-dit-dit*."

"O is *dah-dah-dah?*"

George grinned. "Say it again, Maisie. I like it. I think 'oo is *dah-dah-dah*, too."

"George! Maybe it's really an SOS message. Turn it back on, please."

He turned it back on. The tobacco ad was still going."—"gentlemen of the most . . . *dit-dit-dit* . . . ing taste prefer the finer taste of Golden Harvest . . . *dit-dit-dit* . . . arettes. In the new package that keeps them . . . *dit-dit-dit* . . . and ultra fresh—"

"It's just S-S-S-S," said George.

"Like a teakettle. Or maybe somebody s-s-stutters. But the Golden Harvest people are going to raise— Say—"

"What, George?"

"Maybe it's deliberate, an advertising gag like L.S.M.F.T. used to be. Just a minute till I—"

He reached over and turned the

dial of the radio a bit to the right, then a bit to the left, and an incredulous look came over his face. He turned the dial to the extreme right, as far as it would go. There wasn't any station there—not even the hum of a carrier wave.

"Dit-dit-dit," said the radio, *"—dit-dit-dit."*

George turned it to the other end of the dial. *"Dit-dit-dit,"* said the radio.

He switched it off and stared at Maisie, without even seeing her, which was hard to do.

"Something wrong, George?"

"I hope so," said George Bailey. "I certainly hope so."

He started to reach for another drink, and changed his mind. He had a sudden hunch that something big was happening, and wanted to sober up to appreciate it.

He didn't have the faintest idea *how* big it was.

"George, what do you mean?"

"I don't know. But Maisie, let's take a run down to the studio, huh? There ought to be some excitement."

April 5, 1947; that was the night the waveries came.

It was a gay night, except for radio technicians. New York was at its best and gayest and the main stem, which is Broadway, running high, wide and expensive. The streets were full of uniforms, mostly uniforms of men already demobilized—due to recent reduction in the armies of occupation—so recently demobilized that they hadn't taken time to buy civvies. Discharge pay burning in their pockets, they wanted Broadway and they took Broadway; or Broadway took them. Fresh shiploads of them daily.

The gaiety was hectic, but it was a surface gaiety, more so than had been the gaiety of the boom years of 1928 and '29. Workers dead weary from overtime in the reconverted factories trying to supply the peak demand for automobiles and radios and juke boxes and pinball games left the factories for a hasty meal, then went out in their automobiles—with car radios blaring—and spent their overtime pay in the juke boxes and pinball machines. Which, of course, increased the demand for those commodities, which increased the overtime of the factories, which increased the overtime pay, which increased the spending and the demand and— Well, you see what I mean.

It was a vicious circle that would eventually have bitten itself.

But the waveries bit first.

April 5, 1947; that was the night the waveries came.

George and Maisie tried in vain to get a cab, and took the subway instead. Oh yes, the subways were still running then. It took them within a block of the MID Network Building.

It was a madhouse. George, grinning, strolled through the lobby with Maisie on his arm, took the elevator to five and for no reason at all gave the elevator boy a dollar. He'd never before in his life tipped an elevator operator.

The boy grinned. "Better stay away from the big shots, Mr.

Bailey," he said. "They're ready to chew off anybody's ears that looks at 'em cockeyed."

"Swell," said George. He left the elevator and headed straight for the office of J. R. McGee, himself. There were strident voices behind the glass door."

"But George," protested Maisie, "you'll be fired!"

"When in the course of human events," said George. "Oh, well, it's worth it. I got money saved up."

"But what are you going to do, George?"

"Stand back away from that door, honey." Gently, but firmly, he moved her to a safe position.

"But what *are* you—"

"This," said George Bailey, soberly.

The frantic voices stopped as he opened the glass door a bit. All eyes turned as he stuck his head in through the crack of the door.

"Dit-dit-dit," he said. *"Dit-dit-dit."*

He ducked back and to one side just in time to escape the flying glass as a paperweight and an inkwell came through the pane.

He grabbed Maisie and ran for the stairs.

"Now we get a drink," he told her.

The bar across from the Network Building was crowded, but it was a strangely silent crowd. Most of them were bunched around the big cabinet radio at one end of the bar.

"Dit," said the cabinet radio. *"dit-dah-d'dah-dit-dahditditdah d'd'-dahditddditititdah—"*

Somebody fiddled with the dial. Somebody asked, "What band is that?" and somebody said, "Police." Somebody said, "Try the foreign band," and somebody did. "This ought to be Buenos Aires," somebody said. The radio said, *"dit-dit-dahditititdditah."*

George squeezed Maisie's arm.

"Lovely," he said. Maybe he meant her and maybe not; it didn't matter at the moment.

Somebody ran fingers through his hair and yelled, "Shut that thing off." Somebody did. Somebody else turned it back on.

George grinned and led the way to a back booth where he'd spotted Pete Mulvaney sitting alone with a tall bottle in front of him.

George seated Maisie and himself across from Pete Mulvaney.

"Hello," he said, gravely.

"Hello," said Pete, who was head of the technical research staff of the MID.

"A beautiful night, Mulvaney; did you see the moon riding high in the fleecy clouds like a golden galleon tossed upon silver-crested whitecaps in a stormy—"

"Shut up," said Pete. "I'm thinking."

"Whiskey sours," said George, to the waiter. He turned back to the brooding man across the table. "Think out loud," he said. "We sit at your feet. But first, how did you escape the looney bin?"

"I'm bounced, fired, discharged."

"Shake," said George, "and then explain."

"I told them what I thought it

was, and they said I was crazy."

"Are you?"

"Yes," said Mulvaney.

"Good," said George. "I don't care what it is, as long as it's nothing trivial. But what the devil *is* it?"

"I don't know. Space, I think. Space is warped."

"Good old space," said George Bailey.

"George," said Maisie, "please shut up. I want to hear this."

"Space is also finite. You go far enough in any direction and you get back where you started." Pete Mulvaney poured himself another drink. "Like an ant crawling around an apple."

"Make it an orange," said George.

"All right, an orange. Suppose the first radio waves ever sent out have just made the round trip. In forty-six years."

"Forty-six years? But I thought radio waves traveled at the speed of light. In forty-six years they could go only forty-six light-years, and *that* can't be around the Universe, because there are galaxies known to be thousands of light-years away, or maybe millions; I don't know. But more than forty-six, Pete."

Pete Mulvaney sighed deeply. "We," he said, "are in the middle of a super-galaxy which is two million light-years in diameter. That is just one galaxy, a medium-sized one, they tell us. Yes, it's more than forty-six light-years around the orange."

"But—"

"But listen to that stuff. Can you read code?"

"Nope, not that fast, anyway."

"Well, I can. That's early American ham. Lingo and all. That's the kind of stuff the air was full of before *broadcasting*. It's the lingo, the abbreviations, the barnyard to attic chitchat of amateurs with keys, with Marconi coherers or Fessenden barreters—and you can listen for a violin solo pretty soon now. And you know what the first phonograph record ever broadcast was? Handel's 'Largo' sent out by Fessenden from Brant Rock in 1906. You'll hear his CQ-CQ any minute now. Bet you a drink."

"Sure, but what was the *dit-dit-dit* that started what's turned into hash since?"

Mulvaney grinned and then his face went blank. He said, "Marconi, George. What was the first *powerful* signal ever broadcast and by whom and when?"

"Marconi? *Dit-dit-dit?* Forty-six years ago?"

"Head of the class. The first transatlantic signal on December 12, 1901. For three hours Marconi's big station at Poldhu with two-hundred-foot masts sent out an intermittent S . . . *dit-dit-dit* . . . while Marconi and two assistants at St. Johns in Newfoundland got a kite-borne aerial four hundred feet in the air and got the signal finally. Across the Atlantic, George, with sparks jumping from the big Leyden jars at Poldhu and 20,000-volt juice jumping off the tremendous aerials—"

"Wait a minute, Pete, you're off

the beam. If that was in 1901 and the first broadcast about 1906, it'll be five years before the Fessenden stuff gets here, on the same route. Even if there's a forty-six light-year short cut across space, and even if those signals didn't get so weak enroute that we couldn't hear them. It's crazy."

"I told you I was crazy," said Mulvaney. "Those signals should be so infinitesimal you couldn't hear them with the best set on Earth. Furthermore, they're all over the band on everything from micro-wave to ten kilocycles, and equally strong on each. Furthermore we've come five years in two hours, which isn't possible. I told you I was crazy."

"But—"

"Listen," said Pete.

A blurred, but unmistakably human voice was coming from the radio, mingling with the cracklings of code. And then music, faint and scratchy and punctuated by *dit-dah,* but nevertheless music. Handel's "Largo."

Only it suddenly climbed in pitch as though modulating from key to key until it became so horribly shrill as to hurt the ear, like an orchestra made up of nothing but piccolos. And kept on going, past the high limit of audibility, until they could hear it no more.

Somebody said, "Shut that thing off." Somebody did, and this time nobody turned the thing back on.

George and Maisie looked at Pete Mulvaney and Pete Mulvaney looked back at them.

"But it can't be," said Pete Mulvaney. "There must be some other explanation. The more I think of it, now, the more I think I'm wrong."

He was right: he was wrong.

"Preposterous," said Mr. Ogilvie. He took off his glasses, frowned fiercely, and put them back on again. He looked through them at the several sheets of copy paper in his hand and tossed them contemptuously to the top of his desk. They slid to rest against the triangular nameplate that read:

B. R. Ogilvie,
Editor-in-Chief

"Preposterous," he said again.

Casey Blair, his star reporter, blew a smoke ring and poked his index finger through it. "Why?" he asked.

"Because . . . why, it's preposterous!"

Casey Blair said, "It is now three o'clock in the morning. The radio interference has gone on for five hours and has reached the point where not a single current program is getting through. Every major broadcasting station in the world has gone off the air.

"For two reasons. One: it wasn't doing a bit of good to stay on the air and waste current, no matter what wave length they were on. Two: the communications bureaus of their respective governments requested them to get off to aid their campaigns with the direction finders. For five hours now—since the first note of interference, they've been

working with everything they've got. And what have they got?"

"Preposterous," said the editor.

"Exactly. Greenwich at 11 p.m. —New York time—got a bearing in about the direction of Miami. It shifted northward until at two o'clock the direction was approximately that of Richmond, Virginia. Now San Francisco at eleven got a bearing in about the direction of Denver; three hours later it shifted southward toward Tucson. Southern hemisphere: bearings from Capetown, South Africa, shifted from approximate direction of Buenos Aires to direction of Montevideo, a thousand miles north. New York had trouble with direction finders; weak indications at eleven were toward Madrid; by two o'clock they could get no bearings at all." He blew another smoke ring. "Maybe because the loop antennae they use turn only on a horizontal plane."

"Absurd," said Mr. Ogilvie.

Casey said, "I liked 'preposterous' better, Mr. Ogilvie. It's not absurd; I'm scared stiff. Those lines converge on about the constellation Leo, if you take them as straight lines instead of curving them around the surface. I did it with a little globe and a star map." He leaned forward and tapped a forefinger on the top copy page. "Stations that are directly under that point in the sky get no bearings at all. Stations on, as it were, the perimeter of the Earth get strong bearings in the horizontal plane."

"But the heaviside layer, Blair—isn't that supposed to stop all radio waves; bounce 'em back or something?"

"Uh-huh. It does. But maybe it leaks. Maybe some waves get through. It isn't a solid wall."

"But—"

"I know; it's preposterous. But there it is. Only there's an hour before press time and you ought to turn the observatories on it and get it more accurately. Get *them* to extend those bearing lines. I did it by rule of thumb. Further, I didn't have the data for checking planet positions. Leo's on the ecliptic; a planet could be in line between here and there. Like Mars, maybe."

Mr. Ogilvie's eyes brightened, then clouded again.

He said, "We'll be the laughing-stock of the world, Blair, if we're wrong."

"And if I'm right?"

Ogilvie picked up the phone and snapped an order that sent every rewrite man into his office for orders.

April 6th headline of the New York *Morning Messenger,* final (5 a.m.) edition:

RADIO INTERFERENCE COMES FROM SPACE: ORIGINATES IN LEO, SAYS SCIENTISTS

May Be Attempt at Communication By Beings Outside Solar System!

All Broadcasting Suspended

RKO and Radio Corporation stocks, closing the previous day at 10¼ and 11½ respectively, opened at 9¾ and 9½ and dropped sharply. By noon, they were off four and five points respectively, when a moderate buying rally brought each of them back a fraction over two points.

Public action was mixed; people who had no radios rushed out to buy them and there was a boom market in portable and table-top receivers. Those who had radios listened as long as their curiosity enabled them to stand it, and then turned them off. Extraterrestrial or not, the programs were a horrible hash.

Oh, there were flashes—times when, for several seconds at a time a listener could recognize the voice of Will Rogers or Geraldine Farrar or could catch a flash of the Dempsey-Carpentier fight. But things worth hearing—even for seconds at a time—were rare. Mostly it was a jumble of soap opera, advertising and off-key snatches of what had once been music. It was utterly indiscriminate, and utterly unbearable for any length of time.

But curiosity is a powerful motive. There *was* a brief boom in radio sets that morning.

There were other booms, less explicable, less capable of analysis. Reminiscent of the Wells-Welles Martian scare was a sudden upswing in the sale of shotguns and sidearms. Bibles sold as readily as books on astronomy—and books on astronomy sold like hotcakes. One section of the country showed a sudden interest in lightning rods—builders were deluged with orders for immediate demonstration.

For some reason which has never been clearly ascertained, there was a run on fishhooks in Mobile, Alabama; every hardware and sporting goods store in that city was sold out of them before noon.

The public libraries had a run on books on astrology and books on Mars. Yes, on Mars—despite the fact that Mars was at the moment on the other side of the Sun and that every newspaper article on the subject stressed the fact that *no* planet was between Earth and the constellation Leo.

And not a radio station on Earth was on the air that morning.

Newspapers were passed from hand to hand because the presses couldn't keep up with the demand. *No news on the radio*—and something big was happening. People waited, in mobs, outside the newspaper offices for each new edition to appear. Circulation managers went quietly mad.

People gathered in curious little knots about the broadcasting studios. MID network doors were locked, although there was a doorman on duty to admit technicians, who were trying to find an answer to the unprecedented difficulty. Some, who had been on duty the previous day, had now spent twenty-four hours without sleep.

George Bailey woke at noon, with only a slight headache. He turned

on his radio, and turned it off quickly again.

He shaved and showered, went out and drank a light breakfast and was himself again. He bought early editions of the afternoon papers, read them, and grinned. His hunch had been right; whatever was wrong with radio, it was nothing trivial.

But *what* was wrong?

The later editions of the evening papers had it.

EARTH INVADED, SAYS SCIENTIST

Thirty-six line type was the biggest they had; they used it. Not a home-edition copy of a newspaper was delivered that evening. Newsboys starting on their routes were practically mobbed. They sold papers instead of delivering them; the smart ones got a quarter apiece for them. The foolish ones who didn't want to sell, because the papers had been bought for their routes, lost them anyway. People grabbed them.

The later home-editions and the finals changed the heading only slightly—from a typographical viewpoint. But it was a big change, just the same:

EARTH INVADED, SAY SCIENTISTS

Funny what moving an S from the ending of a verb to the ending of a noun can do.

Carnegie Hall shattered precedents that evening with a lecture given at midnight. An unscheduled and unadvertised lecture. Professor Helmetz had stepped off the train at eleven-thirty and a mob of reporters had been waiting for him. Helmetz, of Harvard, had been the scientist—singular—who had made the first headlines.

Harvey Ambers, director of the board of Carnegie Hall, had pushed his way through the mob. He arrived minus glasses, hat and breath, but got hold of Helmetz's arm and hung on until he could talk again. "We want you to talk at Carnegie, professor," he shouted into Helmetz's ear. "Thousand bucks for a lecture on the 'vaders!"

"Certainly. Tomorrow afternoon?"

"Now! I've a cab waiting. Come on."

"But . . . but—"

"We'll get you an audience. Hurry!" He turned to the mob. "Let us through! You can't hear the professor here. Come to Carnegie and he'll talk to you. Spread the word."

The word spread so well that Carnegie Hall was jammed by midnight when the professor began to speak. By twelve-thirty, they'd rigged a loud-speaker system so the people outside could hear. By one o'clock in the morning the streets were jammed for blocks around.

There wasn't a sponsor on Earth with a million dollars to his name who wouldn't have given a million dollars to sponsor the broadcasting of that lecture—but it was not broadcast on the radio.

The line was busy.

"Questions?" asked Professor Helmetz.

A reporter in the front row made it first. "Professor," he asked, "have *all* direction-finding stations on Earth confirmed your statement as to the change this afternoon?"

"Yes, absolutely. At about noon, the directional indications began to grow weaker. At 2:47 o'clock, New York time, they ceased completely. Until then, the radio waves emanated from the sky, constantly changing direction with reference to the Earth's surface, but *constant* with reference to the point in the constellation Leo."

"What star in Leo?"

"No star. Merely a point in the sky coinciding exactly with the position of no visible star on the most minute charts. At 2:47 o'clock all direction finders went dead, but the signals persisted. They came from *all sides* equally. The invaders were here. There is no other conclusion to be drawn. Earth is now surrounded, completely blanketed, by radio waves which have *no point of origin,* which travel ceaselessly around the Earth in all directions, changing shape at their will—which at the moment seems to be in imitation of the Earth-origin signals which attracted their attention, which brought them here."

"From nowhere? From just a point in space?"

"Why not, sir? They are creatures of *ether,* not of matter. Ether permeates space uniformly. They were, until they were attracted here, at a point in space not greater than twenty-three light-years away. Our first indication of their arrival—rather, the arrival of the first ones, if you want to put it that way—came with a repetition of Marconi's S-S-S transatlantic broadcast of forty-six years ago. Apparently that was the first Earth broadcast of sufficient power to send signals which they could perceive at that distance. They started for Earth then, presumably. It took twenty-three years for those waves to reach them and twenty-three years for them to reach us. The first to arrive had formed themselves, imitatively, to duplicate the shape, as it were, of the signals that attracted them. Later arrivals were in the form of other waves that they had met, or passed, or absorbed, on their way to Earth. There are now fragments of programs which were broadcast as recently as a few days ago . . . uh . . . wandering about the ether. Undoubtedly also there are fragments of the very last programs to be broadcast, but they have not yet been identified."

"Professor, can you *describe* one of the invaders?"

"No more than one can describe a radio wave. They *are* radio waves, in effect, although they emanate from no broadcasting station. They are a form of life dependent upon the movement of ether, as life as we know it is dependent upon the vibration of matter. Life is movement—or at least, life is contingent upon movement."

"They are different sizes?"

"Yes—in two senses of the word

size. Radio waves are measured from crest to crest, which measurement is known as the wave length. Since the invaders cover the entire dials of our receiving sets, obviously they can—in imitation, undoubtedly of the waves of ours which they have met—adjust themselves to any frequency, or crest-to-crest wave length.

"But that is only a crest-to-crest length. The actual length of a radio wave is much greater. If a broadcasting station sends out a program of one second's duration, the length of the wave carrying that program is one light-second, or 186,270 miles. A half-hour program is on a continuous wave, as it were, one-half light-hour long, and so on.

"On that basis, the individual . . . uh . . . invaders, vary in length from a hundred thousand miles long—less than a second in duration—to about five million miles long—almost half a minute in duration. Each is in constant movement at the speed of light, and presumably that movement is now in a circle about the surface of the Earth. Each wave, as it were, extends many times, or many thousands of times, around the Earth."

"How can that be told?"

"By the length of the . . . ah . . . excerpts from various programs. None are under half a second in duration, none over half a minute."

"But why assume, Professor Helmetz, that these . . . these waves are living things? Why not just inanimate waves?"

"An inanimate wave . . . as you call it . . . would follow certain laws. Just as inanimate matter follows certain laws. An animal can climb uphill, however, or run in circles, or . . . uh . . . climb a tree. A stone can do none of these unless impelled by some outside force. It is the same with these invaders. They are living things because they show volition, because they are not limited in direction of travel, because they can change their form—because they *retain their identity;* two signals never come together on the same radio or conflict with one another. They follow one another, but do not come simultaneously. They do not blend or heterodyne as signals on the same wave length would ordinarily do. They follow laws and rules of their own. They are *not* merely radio waves."

"But, professor, are they intelligent beings?"

Professor Helmetz took off his glasses and polished them thoughtfully. He said, at length, "I doubt if we shall ever know. The intelligence of such beings, if any, would be on such a completely different plane from ours that there would be no common point from which we could start intercourse. We are material; they are immaterial. I do not think there can ever be common ground between us."

"But if they are intelligent at all, professor—"

"Ants are intelligent, after a fashion. Even if one calls it instinct that enables them to do such marvelous things, still instinct is a form of intelligence. Yet we can-

not communicate with ants; we shall be less likely to communicate with the invaders. The difference in type between ant-intelligence and ours would be nothing to the difference in type between the intelligence of the invaders and our own. What *could* we have to say to one another?"

The professor must have had something there. Communication with the vaders—a clipped form, of course, of *invaders*—was never established.

Radio stocks stabilized on the exchange. Until, a day after the midnight lecture, someone asked Dr. Helmetz the sixty-four dollar question and the newspapers published his answer:

"Resume broadcasting? I don't know. Not until the invaders go away and why should they? Unless, of course, radio communication is perfected on some other planet in some other galaxy, and they're attracted there."

"And if they did go away—?"

"Oh, they'd be back when we started to broadcast again."

Radio stocks dropped to practically zero in an hour. There wasn't any frenzied scene on the Exchange, however; no frenzied selling, because there was no buying, frenzied or otherwise. No radio stocks exchanged hands.

Radio musicians took jobs in theaters, taverns and the like. And failed completely to fulfill the increased demand for talent. With radio out, other forms of entertainment boomed.

Magazine sales boomed. Movies boomed. Vaudeville was coming

back. Everything boomed except radio.

"One down," said George Bailey. The bartender asked what he meant.

"I dunno, Hank. I got a hunch."

"What kind of hunch?"

"I don't even know that. Shake me up one more of those, and I'll go home."

The electric shaker wouldn't work, and Hank had to shake it up by hand.

"Exercise; that's what you need," said George. "Take some of that fat off you."

Hank grunted and the ice tinkled merrily as he tilted the shaker to pour out the drink.

George Bailey drank it leisurely and strolled out into an April thundershower. He stood under the awning, and watched for a taxi. An old man was standing before him.

"Some weather," George said.

The old man grinned at him. "You noticed it?"

"Huh? Noticed what?"

"Just watch a while, mister. Just watch a while."

The old man moved on. George stood there quite a while—for no cab went by empty—before he got it. His jaw fell down a trifle, and then he closed his mouth and went back into the tavern. He went into a phone booth and called Pete Mulvaney.

He got three wrong numbers and lost four nickels before he got Pete. Pete's voice said, "Yeah?"

"George Bailey, Pete. Listen, the weather. Notice it?"

"Yes. What's it mean, you want to know. So do I. You tell me. I think it's—" A crackling sound on the wire blurred it out.

"Hey, Pete. You there?"

The sound of a violin. Pete Mulvaney didn't play violin.

"Hey, Pete. What in—"

Pete's voice again. "Come on over, George. This isn't going to last long. Bring—" A buzzing noise and then a voice that was not Pete's said, "—come to Carnegie Hall. The best tunes of all come to Carnegie Hall. Yes, the best tunes of all come to Car—"

George slammed down the receiver.

He walked through the rain to Pete's place. On the way he bought a bottle of Scotch. Pete had started to tell him to bring something, and maybe, he figured, that was what it was.

It was.

They poured a drink apiece and lifted them. The lights flickered briefly, went out, and then on again.

"No lightning," said George. "No lightning and pretty soon no lighting. They're taking over the telephone. What do they do with lightning, though?"

"Eat it maybe."

"No lightning," said George. "I can get by without a telephone, and candles and oil lamps aren't bad for lights, but I'm going to miss lightning. I *like* lightning."

Pete Mulvaney leaned back in his chair. He said, "Electric lights, electric toasters, electric hair-curlers, vacuum cleaners. Electric power, and—automobiles and airplanes and Diesel-engined boats. George do

you know no gasoline engine can work without electricity?"

"Huh? For a starter, sure, but can't it be cranked by hand?"

"Yes, but the *spark.*"

"Yes, the spark. Hey, how about these new rocket planes? Those, too?"

"Those, too."

"Movies?"

"Definitely, movies. You couldn't work a projector with an oil lamp. You need concentrated light for that. And sound-tracks—well, that's electricity *per se.*"

George Bailey shook his head slowly. "All right, scratch movies. Streetcars. Trucks, tanks, toasters— See what it means, Pete?"

Pete poured another drink. "It means we're going back to the original source of horsepower. Horses. If you want to invest, buy horses. Particularly mares; mares are going to be worth their weight in gold."

"Hey, though, there are steam engines. Locomotives."

Pete Mulvaney nodded. "The iron horse. We'll be back to it for the long hauls, and back to Dobbin for the short ones. Can you ride?"

George sipped his drink slowly. "Used to when I was a kid. Guess I can learn again. Say, it'll be fun. And say—"

"What?"

"Used to play cornet when I was a kid. Think I'll get one and learn again. That'll be fun, too. And maybe I'll hole in somewhere and write that nov— Say, what about printing?"

"They printed books long before electricity. Take a while to readjust the printing industry, but there'll be books and magazines, all right."

George Bailey grinned and got up. He walked over to the window and looked out and down into the storm. A streetcar was stalled in the middle of the block outside. Behind him, the lights flickered again. An automobile stopped, then started more slowly, stopped again.

A neon light across the way suddenly went dark.

He looked up at the sky, and sipped his drink.

"No lightning," he said. He was going to *miss* the lightning.

The changeover, for a wonder, went smoothly.

The government, having had experience of a multiplicity of divided authorities, created one board with practically unlimited authority, and under it three subsidiary boards. The main board, called the Economic Readjustment Bureau, had only seven members and its job was to co-ordinate the efforts of the three subsidiary boards and to decide, quickly and without delay, any jurisdictional disputes among them.

First of the three subsidary boards was the Transportation Bureau. It immediately took over, temporarily, the railroads. It ordered Diesel engines run on sidings and left there, organized use of the steam locomotives and solved the problems of railroading sans telegraphy and electric signals. It dictated, then, what should be transported; food coming first, coal and

fuel oil second, and essential manufactured articles in the order of their relative importance. Carload after carload of new radios, electric stoves, refrigerators and such useless articles were dumped unceremoniously alongside the tracks, to be salvaged for scrap-metal later.

All horses were declared wards of the government, graded according to capabilities, and put to work or to stud. Draft horses were used for only the most essential kinds of hauling. The breeding program was given the fullest possible emphasis; the bureau estimated that the equine population would double in two years, quadruple in three, and that within six or seven years there would be a horse in every garage in the country.

Farmers, deprived temporarily of their horses, and with their tractors rusting in the fields, were instructed how to use cattle for plowing and other work about the farm, including light hauling.

The second board, the Manpower Relocation Bureau, functioned just as one would deduce from its title. It handled unemployment benefits for the millions thrown temporarily out of work and helped relocate them—not too difficult a task considering the tremendously increased demand for hand labor in many fields. In May of 1947 thirty-five million employables were out of work; in October, fifteen million; by May of 1948, five million. By 1949 the situation was completely in hand and competitive demand was already beginning to raise wages.

The third board had the most difficult job of the three. It was called the Factory Readjustment Bureau. It coped with the stupendous task of converting factories filled with electrically operated machinery and, for the most part, tooled for the production of other electrically operated machinery, over for the production, without electricity, of essential nonelectrical articles.

The few available stationary steam engines worked twenty-four hour shifts in those early days, and the first thing they were given to do was the running of lathes and stampers and planers and millers working on turning out more stationary steam engines, of all sizes. These, in turn, were first put to work making still more steam engines. The number of steam engines grew by squares and cubes, as did the number of horses put to stud. The principle was the same. One might—and many did—refer to those early steam engines as stud horses. At any rate, there was no lack of metal for them. The factories were filled with nonconvertible machinery waiting to be melted down.

Only when steam engines—the basis of the new factory economy—were in full production, were they assigned to running machinery for the manufacture of other articles. Oil lamps, clothing, coal stoves, oil stoves, bathtubs and bedsteads.

Not quite all of the big factories were converted. For while the conversion period went on, individual handicrafts sprang up in thousands of places. Little one- and two-man shops sprang up, making and repair-

ing furniture, shoes, candles, all sorts of things that *could* be made without complex machinery. At first these small shops made small fortunes because they had no competition from heavy industry. Later, they bought small steam engines to run small machines and held their own, growing with the boom that came with a return to normal employment and buying power, increasing gradually in size until many of them rivaled the bigger factories in output and beat them in quality.

There *was* suffering, during the period of economic readjustment, but less than there had been during the great depression of the early 1930s. And the recovery was quicker.

The reason was obvious: In combating the depression, the government was working in the dark. They didn't know its cause—rather, they knew a thousand conflicting theories of its cause—and they didn't know the cure. They were hampered by the idea that the thing was temporary and would cure itself if left alone. Briefly and frankly, they didn't know what it was all about and while they experimented, it snowballed.

But the situation that faced the country—and all other countries—in 1947 was clear-cut and obvious. No more electricity. Readjust for steam and horsepower.

As simple and clear as that, and no ifs or ands or buts. And the whole people—except for the usual scattering of cranks—back of them.

By 1951—

It was a rainy day in April and George Bailey was waiting under the sheltering roof of the little railroad station at Blakestown, Connecticut, to see who might come in on the 3:14.

It chugged in at 3:25 and came to a panting stop, three coaches and a baggage car. The baggage car door opened and a sack of mail was handed out and the door closed again. No luggage, so probably no passengers would—

Then at the sight of a tall dark man swinging down from the platform of the rear coach, George Bailey let out a yip of delight. "Pete! Pete Mulvaney! What the devil—"

"Bailey, by all that's holy! What are you doing here?"

George was wringing his hand. "Me? I live here. Two years now. I bought the Blakestown *Weekly* in '49, for a song, and I run it—editor, reporter, and janitor. Got one printer to help me out with that end, and Maisie does the social items. She's—"

"Maisie? Maisie Hetterman?"

"Maisie Bailey now. We got married same time I bought the paper and moved here. What are you doing here, Pete?"

"Business. Just here overnight. See a man named Wilcox."

"Oh, Wilcox. Our local screwball—but don't get me wrong; he's a smart guy all right. Well, you can see him tomorrow. You're coming home with me now, for dinner and to stay overnight. Maisie'll be glad to see you. Come on, my buggy's over here."

"Sure. Finished whatever you were here for?"

"Yep, just to pick up the news on who came in on the train. And *you* came in, so here we go."

They got in the buggy, and George picked up the reins and said "Giddap, Bessie," to the mare. Then, "What are you doing now, Pete?"

"Research. For a gas-supply company. Been working on a more efficient mantle, one that'll give more light and be less destructible. This fellow Wilcox wrote us he had something along that line; the company sent me up to look it over. If it's what he claims, I'll take him back to New York with me, and let the company lawyers dicker with him."

"How's business, otherwise?"

"Great, George. *Gas;* that's the coming thing. Every *new* home's being piped for it, and plenty of the old ones. How about you?"

"We got it. Luckily we had one of the old Linotypes that ran the metal pot off a gas burner, so it was already piped in. And our home is right over the office and print shop, so all we had to do was pipe it up a flight. Great stuff, gas. How's New York?"

"Fine, George. Down to its last million people, and stabilizing there. No crowding and plenty of room for everybody. The *air*—why, it's better than Atlantic City, without gasoline fumes."

"Enough horses to go around yet?"

"Almost. But bicycling's the craze; the factories can't turn out enough to meet the demand. There's a cycling club in almost every block and all the able-bodied cycle to and from work. Doing 'em good, too; a few more years and the doctors will go on short rations."

"You got a bike?"

"Sure, a pre-vader one. Average five miles a day on it, and I eat like a horse."

George Bailey chuckled. "I'll have Maisie include some hay in the dinner. Well, here we are. Whoa, Bessie."

An upstairs window went up, and Maisie looked out and down. She called out, "Hi, Pete!"

"Extra plate, Maisie," George called. "We'll be up soon as I put the horse away and show Pete around downstairs."

He led Pete from the barn into the back door of the newspaper shop. "Our Linotype!" he announced proudly, pointing.

"How's it work? Where's your steam engine?"

George grinned. "Doesn't work yet; we still handset the type. I could get only one steamer and had to use that on the press. But I've got one on order for the Lino, and coming up in a month or so. When we get it, Pop Jenkins, my printer, is going to put himself out of a job by teaching me to run it. With the Linotype going, I can handle the whole thing myself."

"Kind of rough on Pop?"

George shook his head. "Pop eagerly awaits the day. He's sixty-nine and wants to retire. He's just staying on until I can do without him. Here's the press—a honey of a little Miehle; we do some job

work on it, too. And this is the office, in front. Messy, but efficient."

Mulvaney looked around him and grinned. "George, I believe you've found your niche. You were cut out for a small-town editor."

"Cut out for it? I'm crazy about it. I have more fun than everybody. Believe it or not, I work like a dog, and like it. Come on upstairs."

On the stairs, Pete asked, "And the novel you were going to write?"

"Half done, and it isn't bad. But it isn't the novel I was going to write; I was a cynic then. Now—"

"George, I think the waveries were your best friends."

"Waveries?"

"Lord, how long does it take slang to get from New York out to the sticks? The vaders, of course. Some professor who specializes in studying them described one as a wavery place in the ether, and 'wavery' stuck . . . Hello there, Maisie, my girl. You look like a million."

They ate leisurely, but volubly. Almost apologetically, George brought out beer, in cold bottles. "Sorry, Pete, haven't anything stronger to offer you. But I haven't been drinking lately. Guess—"

"*You* on the wagon, George?"

"Not on the wagon, exactly. Didn't swear off or anything, but haven't had a drink of strong liquor in almost a year. I don't know why, but—"

"I do," said Pete Mulvaney. "I know exactly why you don't—because I don't drink much either, for the same reason. We don't drink because we don't *have* to . . . say, isn't that a *radio* over there?"

George chuckled. "A souvenir. Wouldn't sell it for a fortune. Once in a while I like to look at it and think of the awful guff I used to sweat out for it. And then I go over and click the switch and nothing happens. Just silence. Silence is the most wonderful thing in the world, sometimes, Pete. Of course I couldn't do that if there was any juice, because I'd get vaders then. I suppose they're still doing business at the same old stand?"

"Yep, the Research Bureau checks daily. They try to get up current with a little generator run by a steam turbine. But no dice; the vaders suck it up as fast as it's generated."

"Suppose they'll ever go away?"

Mulvaney shrugged. "Helmetz thinks not. He thinks they propagate in proportion of the available electricity. Even if the development of radio broadcasting somewhere else in the Universe would attract them there, some would stay here—and multiply like flies the minute we tried to use electricity again. And meanwhile, they'll live on the static electricity in the air. What do you do evenings up here?"

"Do? Read, write, visit with one another, go to the amateur groups—Maisie's chairman of the Blakestown Players, and I play bit parts in it. With the movies out, everybody goes in for theatricals and we've found some real talent. And there's the chess-and-checker club, and cycle trips and picnics . . . there

isn't time enough. Not to mention music. Everybody plays an instrument, or is trying to."

"You?"

"Sure, cornet. First cornet in the Silver Concert Band, with solo parts. And— Good heavens! Tonight's rehearsal, and we're giving a concert Sunday afternoon. I hate to desert you, but—"

"Can't I come around and sit in? I've got my flute in the brief case here, and—"

"*Flute?* We're short on flutes. Bring that around and Si Perkins, our director, will practically Shanghai you into staying over for the concert Sunday—and it's only three days, so why not? And get it out now; we'll play a few old-timers to warm up. Hey, Maisie, skip those dishes and come on in to the piano!"

While Pete Mulvaney went to the guest room to get his flute from the brief case, George Bailey picked up his cornet from the top of the piano and blew a soft, plaintive little minor run on it. Clear as a bell; his lip was in good shape tonight.

And with the shining silver thing in his hand he wandered over to the window and stood looking out into the night. It was dusk out and the rain had stopped.

A high-stepping horse *clop-clopped* by and the bell of a bicycle jangled. Somebody across the street was strumming a guitar and singing. He took a deep breath and let it out slowly.

The scent of spring was soft and sweet in the moist air.

Peace and dusk and distant rolling thunder. Thunder, but— "I wish," he said softly, "there was a bit of lightning. I *miss* the lightning."

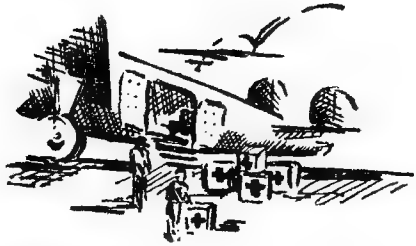
THE END.

NON-SUPER-COLOSSAL

All the extra-solar planets so far discovered have been of the same general class —super-planets, so large and massive that there was some discussion as to their classification as dark, dwarf suns or giant planets.

This indicates nothing whatever with respect to the structure of extra-solar planets—but it does emphasize one necessary failing of the only known method of locating them. We can, with present techniques, find planets only when they are circling one of a pair of close binary stars, and they must, furthermore, be massive enough to swing appreciably the primary about which they revolve. To allow mathematical unscrambling of the resultant complex movements, the planet must either be single, or one of the group present must completely swamp out all other perturbations caused by smaller planets. Sol necessarily yields somewhat to the pull of each of the planets of our system—he's swinging nine ways at once, and unscrambling that would be a task for mathematical machines beyond our present resources.

There is, then, an inherent near-impossibility in finding earthlike planets. Even the super-colossals are far too small to be directly seen by reflected light at so tiny an angle from the enormously luminous suns they circle; seeing small planets is hopeless. Those we'll have to find with spaceships. Perhaps we can find some from the Lunar Observatory, but in any case spaceships come first—

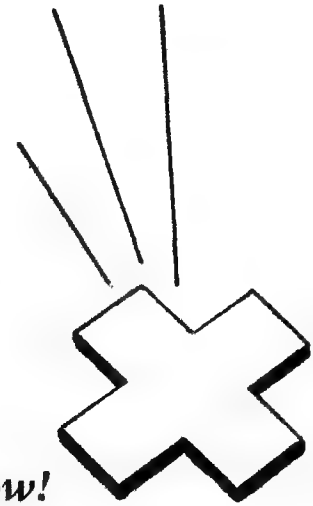


"Without It, He'd Be Dead Right Now!"

"One thing saved him. Plasma. So if he gets well, he has *you* to thank. . . . Housewife Jones, Stevedore Smith, Sophomore Brown!"

And if he didn't get the plasma . . . if he didn't get well . . . would he have *you* to blame? You, who mean to go to the Red Cross blood bank, but never quite get around to it?

Don't give it a chance to happen. Go to your blood bank NOW . . . and win a soldier's undying gratitude—as well as —perhaps—his life!



The RED CROSS Needs Your BLOOD. . . . Now!

"They Were Dead—"

by WILLY LEY

When I reported about those Russian experiments at the Medical Institute of Voronezh—(see: *Astounding,* June 1944 issue)—where freshly killed dogs were revived after fifteen or twenty minutes of unquestionable death I suspected, of course, that this method might be used at some future time on human beings, victims of accidents.

A long report published in *Pravda* of September 11, 1944, shows that the future is now. Soviet physicians, working in field hospitals just behind the front lines, oftentimes under German artillery fire, have succeeded in restoring life in twelve out of fifty-one cases to soldiers who had died of their wounds. This work, carried out under the direction of Dr. Vassilij A. Negovsky, was based on the experience and knowledge gained in the dog experiments and the technique employed was evolved from the technique developed during those experiments.

It consisted, in the main, in forcing air directly into the lungs of the dead soldiers and in forcing blood—presumably highly oxygenated—into a large artery leading directly to the heart.

The difference between the forcing of air into the lungs by means of a rhythmically working mechanism and the customary methods of artificial respiration is easy to discern. The customary method tries to stimulate the lungs, to coax them into resuming their work. The new method puts the burden of the work upon the machine. It is not the lungs that breathe, but the machine breathes into the lungs. When the simultaneously introduced blood has succeeded in making the heart beat again, the lungs will take over by themselves.

One case quoted is that of the soldier Alexander Nosoff who had part of his leg torn off by an artillery shell. An operation was indicated, but fourteen hours after the injury the soldier began to show the outward signs of death. Ordinary blood transfusions and injections of caffeine and camphor had, of course, been administered, but had only served to postpone death, without being able to improve the patient's condition. The field surgeons were forced to conclude that the case was hopeless. Then that special "front-line brigade," as the Russians call it, went to work, with blood injection into the main artery and forced breathing. After a few hours the required operation could be performed, and two days after his

death soldier Nosoff was moved to a hospital in the rear; alive.

The soldier Valentin Tcherepanoff of one of the Guards regiments was pronounced dead at 7:41 p. m. on March 3, 1944 by the medical officer in charge, having died during an emergency operation on a bad hip wound—shell splinter—which had caused external as well as internal hemorrhages. The cause of death was mainly loss of blood. At 7:45 p. m. the special medical brigade went to work. At 7:46 soldier Tcherepanoff's heart beat again, at 7:49 his lungs took over from the machine. At 9 p. m. the first signs of consciousness reappeared.

It is obvious that such battlefield surgery cannot be as efficient and as sure of its success as the laboratory surgery with which this development was initiated. But it did work in a little better than one out of every ten cases and such a ratio is nothing short of miraculous. In fact it would be nothing short of miraculous if it had only worked once so far—whether on the battlefield or in a big-city peace-time hospital. It must always be borne in mind that these cases are not simply very severe cases which are declared hopeless by some doctors while others, presumably better doctors, still try something else and succeed. These were not such "hopeless" cases of ordinary medical parlance. These men had *died!* They had taken the one irrevocable step—and it had been revoked!

The main requirement of the new method seems to be speed—the crux of the matter is, as had been suspected, the delicate human nervous system. Those dogs of Voronezh could stay dead for fifteen or even twenty minutes without any harm to their nervous system. But the human nervous system is more highly developed, all-around "better," but also more delicate. The time limit established by the physicians of the "front-line brigade" is five to six minutes only; if the patient is dead for a longer time, the nervous system undergoes changes with which present-day medical science cannot yet cope.

Research men will probably find ways and means to do something about this limiting factor in times to come, but until they do a man who was dead for a longer period than five minutes had best stay dead.

THE END.

DON'T WAIT . . .

Until there isn't an available copy of your favorite magazine. A whole year of reading pleasure, thrills and chills, can be had by just filling in this coupon and sending it to us immediately. Don't wait—act now!

ASTOUNDING SCIENCE-FICTION
122 EAST 42nd STREET
NEW YORK 17, N. Y.

Enclosed is $2.50. Kindly send me a year's subscription to ASTOUNDING SCIENCE-FICTION.

NAME .....

ADDRESS .....

CITY ..... STATE.....

Brass Tacks

Nothing To It!

Dear Mr. Campbell:

Much against my better nature I must hold Mr. Shelton up to scorn and ridicule. He is ignorant. He doesn't manufacture his so-called #1-A vacuum. He must have stolen his supply from my laboratory. I have instructed my lawyers to look into this bare-faced robbery.

The case against Mr. Shelton follows: The vacuums produced in the Sproul Laboratories are the finest and emptiest vacuums in the world and are produced in the following manner; viz and to wit: A landowner is about to extract posts, poles or other buried objects from the ground. In advance, I, personally, purchase the empty hole. As the object is withdrawn from the ground, my assistants place the hole, in its absolute purity, in the—patented—Sproul Vacuum Holder—not for sale. The vacuum is transported to our laboratory where it is graded and sawn into proper sizes. This is the soft or common variety and is on sale at all drugstores, hardware and novelty counters.

The HARD vacuum is another matter, it is to be found only in the winter and in rather inaccessible places. By the same method which I have shown in the previous paragraph, the hard vacuum is obtained as the icicles are removed from department store cornices. And if you think our price for the genuine article is high, think of the poor chap that has to stand six feet out from the edge of a roof in order to capture the vacuum before it spoils.

Now for what Mr. Shelton calls the #1-A type which he says is heavy and for which heaviness he can give no reasonable answer. It is quite evident that this point clinches my case. The heavy type of vacuum is the result of removing old-fashioned iron hitching posts from Portland cement bases. As no new hitching posts have been installed in

the last thirty years, it is evident that the vacuum obtained from this point will be at least thirty years in close proximity to iron which is a heavy substance—or so I have been told. Any child may try the experiment of bopping grandpa on the noggin with an iron pot to prove this.

A third type of vacuum which we hope to put on the market in the near future is amorphous vacuum. This is obtained in small quantities from the brains of the people who sold America short. It is difficult to obtain in this country although we have found some of a very low grade. I am told that there is more to be had in Germany and Japan but an unfeeling State Department refuses to issue a commercial passport to my agent in order that he may investigate the production area. However, I am hoping that General Eisenhower will be in Berlin shortly and General MacArthur in Tokio and I shall write them to send me a few heads for samples, Hitler's and Tojo's are the preferred articles. I think that either will yield a fair amount of vacuum.—T. Augustus Sproul, Jr.

I hadn't noticed that initial "C."

Dear Mr. Campbell:

Having just devoured the September issue of Astounding I will now rate the stories for the Analytical Laboratory.

1. The third installment of "Renaissance." After reading Jones' "Fifty Million Monkeys" I doubted if anyone could write a better tale and now Mr. Jones seems to have topped himself with "Renaissance." If the first three parts are any indication, the last part will be something. A+

2. "Census"—This is an excellent series and gets better as it develops. A

3. "Culture"—You certainly like one-word titles beginning with C. In the past few issues there have been "Changeling," "City," "Cuckoo," "Census" and "Culture." I believe this the first story by Shelton I've read, but then I've only been reading ASF for a year and a half.

4. "A Can of Paint"—Looks like Van Vogt is starting a series, too. A—

5. "Hobo God"—Anything of Jameson's is bound to be good. A—

6. "Business of Killing"—Last but still very good. B+

I'm glad to see that George O. Smith and Wesley Long haven't had anything in the mag for the past few issues. Keep it up.

September issue as a whole is best this year, so far.

Probability Zero:

1. "The Thirty-first of June"—Holby

2. "An Icicle Built for Groo"—Pomeroy

3. "A Matter of Relativity"—Anderson.—Ralph Glisson, 542 Prescott Road, Merion, Pennsylvania.

The really good ideas—the ones we want to talk about and write about—have, quite literally, gone to war. A simple list of the

things we can't *write about would convince any science-fictionist that the magazine was at war!*

Dear Mr. Campbell:

Since I have been a steady reader of Astounding since the issue of December, 1934, I think I may safely consider myself a member of the family, and shall, with little more ado, venture a few opinions on the mag now and as it has been.

I read Mr. Carrithers' letter in Brass Tacks in the November '43 issue with a good deal of interest. His point that the entire background of the magazine should be used as a standard instead of the contents of each individual issue is well taken, but I should like to suggest that it would be hard to apply. Let me illustrate what I mean by giving my own highly personal list of the best stories published in these nine and a half years.

1. "Gray Lensman"—Smith
2. "Slan!"—van Vogt
3. "The Mightiest Machine"—Campbell
4. "Galactic Patrol"—Smith
5. "Second Stage Lensman"—Smith
6. "Gather, Darkness!"—Leiber
7. "The Weapon Makers"—van Vogt
8. "The Cometeers"—Williamson
9. "Final Blackout!"—Hubbard
10. "Universe"—Heinlein
11. "Nerves"—MacDonald
12. "Recruiting Station"—van Vogt

At this point so many other stories occur to me that I must confess my incompetence to rank one higher than another, and therefore will stop after these twelve.

I've noticed several pronounced trends in Astounding during this period. One of the most obvious, shown by the fact that only one of the stories—and that one your own—was not published under your editorship, is that the magazine has very greatly improved since you took over.

But the most important is that of the authors' style. Until about 1937 the prevailing style was that of such stories as "Alas, All Thinking," "Finality Unlimited," and "The Red Peri": which might well be described as craggy. Most of these stories, like the first two just named, went rather far afield for my taste, especially for a magazine which claimed to be printing "science-fiction." Actually, the science was almost completely lacking. The authors, almost without exception, devoted their talents to picking out the most wildly impossible ideas, and seem to have taken very little trouble to write well about them. (This last clause does not refer to imagination, of which there was certainly enough, but simply to the prevalent literary style, which matched the untrimmed pages very well indeed.)

Perhaps it was Smith's Bergenholms, DeLameters, and maulers that wrought the change, though probably not unaided by certain other factors which I don't care to worry about here. At any rate, as soon as trimmed edges came in, late

in '36, an increasing trend toward an emphasis on science and more skillful literary technique began to manifest itself. George O. Smith's very fine Venus Equilateral tales are the most obvious examples of this.

Between 1941 and 1943 we saw the highest development of Astounding; from this period are drawn seven of my twelve all-time favorites. During these years the mag printed neither SCIENCE-fiction nor science-FICTION, but rather what its title would suggest. I would be very hard put to it to find one story or article during this entire period which I could say was poor. The novels were especially good, but this was because we saw three or four times as much of them as of the shorts.

But since mid-'43, when you went back to the small size, the stories have been regressing in quality. They are more highly polished, true: in fact, one can almost see them glitter, but this alone does not make a story great or even good. Outside of Van Vogt's "The Changeling," I don't believe there has been a really new idea in any of the six issues so far this year. There are no serials, except for Hull's "The Winged Man," which I should cheerfully nominate for the title of "worst serial ever printed." I suppose this may be due to the paper shortage and also to the withdrawal from circulation of Smith, Heinlein, MacDonald, and several of the others who were the greatest in the field.

I shouldn't care to have to give "Trog" an all-time rating, because it wouldn't come, at best, higher than 400, and a classification down in that range would take too much time and energy. One could say "Slickly written—this is not necessarily a compliment—and well plotted, but still not great," but that wouldn't be very definite.

I am eagerly awaiting the time when you can reassemble all the authors of your years of glory, go back to the large size with its greater wordage, reprint some of the greatest favorites of the past—because I don't like to tear apart half a dozen issues to get the parts of a serial out—and effect a number of other obvious improvements. Then we can go ahead with Mr. Carrithers' suggestion. However, at present—and I say this reluctantly, because, after all: 1. this is war, and 2. Astounding is still far and away the best in the field—I think you are headed down the wrong track.

And please, when the war's over, don't forget *Unknown Worlds!* That mag achieved a great deal of distinction during its short life, and it distressed me no end to see it withdrawn.—Louis Meites, Jr., 24 South Starr Hall, Middlebury College, Middlebury, Vermont.

The high speed of modern communications makes a difference, I suspect.

Dear Mr. Campbell:

I checked up on Heinlein's History that appeared in your May

1941 issue, and I believe that his sequence is probably correct but his timing is probably wrong. Using the data from the various Cambridge Histories on five different cultural eras and parts of a sixth, the periods average as follows:

Heinlein	Cambridge Average
1910-1960—50 years *Time of Trouble*	191 years
1970-2020—50 years Interplanetary Imperialism (First Empire)	172 years
2020-2025—5 years "New Crusade" (Revolutionary Transition)	79 years
2025-2075—50 years "Prophets' Dictatorship" (Second Empire)	179 years

The cultural eras used were:

European	—Greco-Roman	219 BC—395 AD
Chinese	—Chin-Han	410 BC—221 AD
Indian—	Mongol-British	1392 AD—date
	Maurya	320-125 BC (Second Empire)
Middle East—	Assyrian-Persian	732-331 BC
	Ottoman	1258-1922 AD

If something like Dr. Wheeler's cyclic theory of climate as the dominating driving force in history is correct, then these averages will be nearer the truth than Heinlein's figures. Of course if technical growth does cause major changes in the political cycle, Heinlein could easily be correct.—George G. Gallagher, 505 North Jackson Street, Glendale 6, California.

Business Opportunities Dept.

Dear Mr. Shelton:

As sole owner of a United States Letter Patent on a process for manufacturing and wholesaling vacuums, I and my associates offer you the opportunity of consolidating with the (Absolutely) Nothing Company of which I am major stockholder. I believe that a combine between your firm and my own will be of advantage to both.

Our production engineers, seeking the proper tools for working high vacuums came up with the sorry discovery that high-speed production means were not readily available with any tool-material known. As you know, machining vacuums to precision is a laborious process that has never been successful on automatic machinery.

Our alternative method to machining is as follows: The vacuum is made by the usual methods. We have been able to get good, hard vacuum by these methods and their production rate is ample. Once the vacuum is created, we then attach a compression-pump and compress the vacuum. Keeping the compressed vacuum below the critical temperature for high vacuums is not difficult, and at the proper pressure, they liquefy. Tanks of liquid vacuum may then be shipped.

Their use is simple. In contrast with the terrific job of machining the vacuum to fit the insides of a polygrid vacuum tube, consider the Smith process of dropping three cubic millimeters of liquid vacuum into the tube, and then raising the temperature above the critical temperature. The vacuum ceases to be a liquid, and the expansion of the vacuum drives the air from the vessel, achieving the perfect vacuum without the necessity of precision machining.

Vacuum to any desired degree is possible with adequate control. And I must say that the improved method outlined above will enable the manufacturer to attain high vacuum in

vessels whose shape will absolutely defy any known methods of machining or shaping. Also, the scrap, or turnings from your machined vacuums must cause considerable trouble in disposal and waste, whereas the Smith process utilizes better than ninety-four percent of the manufactured vacuum.

Normally, I would not consider joining a backward firm like yours. But I am forced against my will to offer you this excellent opportunity because of a small misfortune.

We have been storing the liquid vacuum in tanks on the roof. Piping carried the vacuum about the building, stopcocks at strategic locations being provided for using the stored vacuum. But during the recent rainstorm, some rain water got into the refrigerator-mechanism that we use to maintain the vacuum below the critical temperature, and the refrigeration ceased.

The temperature of our storage tanks rose above the critical temperature and the tanks burst. This spilled liquid vacuum all over our plant, where it combined physically with the substance of the building, all of our expensive machinery, and some of the surrounding territory. The jagged crater stops, luckily, just short of the City Water Supply pipes, otherwise high vacuum might be emanating from all the sink faucets in the city.

I await your reply, and urge you to consider consolidation.—George O. Smith, Producer of Absolutely Nothing.

Geography and Cosmography?

Dear Campbell:

Frequently I notice in stories of interstellar civilization, a character will casually refer to the forms of life on Rigellian planets, the government of Norlamin, or something he saw on Ganymede, and the other characters know what he's talking about. But I wonder if it will be that way.

The geographical ignorance of the American people is a public scandal. When normal men can be found in New York who don't know where or what Maine is, it's not surprising that they have very hazy ideas about the nations of the Middle East or the location of the Gilberts with respect to the Solomons. Probably Europeans are in no better condition for locations outside their own continent. And the war has done less than might be expected in educating people along these lines. Really, the field of geography is too complex to expect the man on the street to be well acquainted with any given part of the world outside his very own region.

For the intellectual, political, and economic leaders it's another matter. We expect, and generally find, that diplomats, international traders, and others will have a pretty complete grasp of the subject. The college-educated class generally, whether they've majored in English or Physics, will usually have noticed and remembered such things as the location of Baffin Land, the capital

of Australia, and the ownership of Angola, simply because of their level of mental activity. Nobody expects them to know the export tonnage of cork and teakwood, but they can probably make a good guess at where the material is produced; they know at least one difference between the Appalachians and the Rockies; they know what South American country speaks Portuguese. This information is of the sort that can be tied into an organic whole. As long as we're confined to Earth, geography is simple enough to get a fair working knowledge. Be able to recognize perhaps ten thousand place names and know the climatic, ethnographic, and other characteristics of a thousand of them, and you can make educated guesses about the others (if you've seen Tucson, you have an idea what Albuquerque's like; know something about Arabia and Persia and you can guess at Syria). And once you've gotten rid of Mercator misconceptions, it isn't hard to form an accurate mental picture of the whole world—after all, it's only the surface of a sphere.

But if and when interstellar flight becomes common, a working picture would have to include intricate relations in three dimensions, distances which are inconceivable, and among the worlds themselves infinite complexity with little chance of systematizing it—because planets of two neighboring stars, or even planets of the same star, may bear much less similarity to each other than to hundreds of other worlds scattered throughout the Galaxy.

In such a situation, I should think that even the men who must use such information in their everyday work would make no attempt to commit it to memory, but depend on reference books or a battery of specialists, even as today an Information attendant at Union Station must consult printed time tables ninety-nine times out of a hundred, and FEA asks ODT or WSA how they can ship.

I doubt that even a specialized astrogator could memorize more than a particular region of space and a few outstanding stars in other parts of the Galaxy. A man like van Vogt's Nexialist would probably not have his mind cluttered up with such information at all, except such as came incidentally in other training, as, "The Jarnevonians have an interesting means of providing incentive for superior work—"

No doubt there will be radical improvements in reference works, but stored knowledge isn't the same as knowledge that you *know*, so that it automatically enters into any thinking that calls for it.

In view of the way rocketry is looking up these days, here's something that might be worth noting in Brass Tacks: Five years ago I took a poll of a score or so science-fictionists, asking when they thought the first rocket would reach the Moon. The most optimistic estimate was about 1950, and they ranged up to several "probably nevers." The average guess was around 1975.—Jack Speer, Washington 25, D. C.

Nomad

(*Continued from page 98*)

of flame moved back as the overloaded detectors found more time to focus upon the incoming horde.

Maynard mopped his forehead, one half at a time to permit at least one eye on the celestial globe during the job. "That was close," he snapped.

"It ain't over yet!" said Williamson shortly.

"No . . . here comes another line of those devils . . . at *Pleiad!*"

"They're not afraid to die!"

"They seem to want it!"

The *Pleiad* stopped the long-range fire and began to take care of the horde that was striking at her direct. *Pleiad* was capable of handling this new attack easily, but it left the brunt of the heavy attack on the *Scorpiad.*

Once more the flashing motes moved inward as the detectors found themselves unable to keep up. And still more of the tiny ships poured into the stream, and the borderline of death moved into almost-contact with the constellation ship.

A burst of flame came from the flank of the *Scorpiad,* and the ports flashed outward, followed by gouts of smoke and incandescence. Four red spots spread outward on the *Scorpiad's* hull, and the constellation ship lost drive. Unable to keep up the deceleration of the rest of the Terran fleet, *Scorpiad* fell out of position and dropped below the fleet—farther and farther ahead.

A blinding flash of flame came and died.

"Gone!" moaned Maynard.

"But what a cost!" said Ben.

"No cost is worth it!" said Maynard. Then he calmed and added: "Accursed business. But we may be ahead in the exchange."

"It's brutal," agreed Ben. "Let's keep 'em from getting another."

"Might be robots."

"Nope. If so, the technicians would have scrambled 'em. What's making now?"

"The fighter cover! It's arrived!"

The incoming jet of Mephistan fighters wavered like a gas flame in a high wind, and scintillations scarred the perfection of the needling ships. The long-range fire of the constellation ships picked off the aimlessly moving ships and as the flaming specks reached an almost-solid appearance, the jet of tiny fighters ceased abruptly.

"Stopped 'em!"

Maynard nodded. "For the time."

The communicator spoke: "Commander to Marshal: Located the mother-fleet."

"Yes?"

"We're hitting them now—as per orders. But this is a warning. If we don't stop 'em first, they'll be there in fifteen minutes. They're on collision course!"

"Expected that," said Guy, worriedly.

"O. K.," said Ben in what he hoped would be an encouragement. "Now we'll see if your battle-plan works."

"I keep worrying that it won't."

"If it didn't have merit," observed Ben dryly, "it wouldn't have been adopted."

"I want to get out there and pitch."

"You gotta stay in here and hope they pitch to your call," said Williamson.

Twelve minutes later, the Mephistan fleet came into long-detector range, and the entire Terran fleet opened fire. The heavies, still circling the fleet, took up the job as soon as they came into range, and the space between became filled with flashes of fire as crossed MacMillan beams neutralized one another and spent their mighty energies in light and heat. The power rooms of the ships became a noisy clatter of automatically opening and closing circuit breakers as the MacMillan overloads worked the safety-circuits. Now and then the ultra-loud clamor of the fuse alarms rang out above the chattering racket, and the power gangs worked furiously to replace master line-fuses while the rest of the ship fumed and fretted without power for offense or defense.

The heavies—the sluggers—got between the constellation ships and the Mephistans, and their super-powered AutoMacs outfought the lighter turret-mounts of the Mephistans.

They took their long-range toll, and then as the Mephistans came into torpedo range, the sluggers fell back through the open-work pattern of the constellation ships. From here on in, the omni-powerful battlecraft would have to face battle with every weapon.

Unleashed energy filled the gap between the fleets, and the sky below the decelerating ships became a blazing graveyard of ruin as the ships lost drive and went free, falling ahead of the main body.

Word flashed through the Terran fleet that the *Centuriad II* had discovered the interference frequency of the Mephistan torpedoes. Technicians in all Terran ships shifted their transmitters to the called frequency, and the torpedoes lost their aiming perfection.

But they were not safe.

Wandering torpedoes continued to roam in among the Terran fleet and touched off fountains of flame and death.

Then from point-blank range, the sub-ships of Terra flashed in through the Mephistan fleet. In one great swarm they came. From the virtual zero of the detectors—that in-close distance that limited the minimum range—torpedoes dropped into being from nowhere and hit full upon ship after ship.

The Mephistan fleet became a flaring holocaust of coruscating flame.

When the fifteen-minute deadline came, the Terrans fought a remainder of the huge Mephistan horde that had tried to stop them. The dead hulls, still incandescent, were easy to dodge, though most of them had fallen free long enough before to have them cross Terra's course ahead rather than at coincidence.

Combining the big turrets of the

sluggers with the primary, secondary, and tertiary batteries of the constellation ships, Terra's forces fairly crushed the fragments of Mephisto's horde that remained.

And then the sky was clear once more. The winking lights of death were silent. The furor and clatter of the instrument rooms ceased more slowly as the alarms continued to pick out detritus and to reject such harmless stuff. The power rooms were quiet, too, and the generator rooms no longer resounded to the scream of overworked generators. A clean-up began, and droplets of metal from blown fuses mingled with blackened bits of contalloy from the circuit breakers. Pyrometers dropped back to the central portion of their scales, and the air, acrid and warm, cooled and became sweet again.

They looked, and saw that the sky was theirs—completely.

Mephisto was a disk in the sky below them.

It beckoned—or did it taunt?

XI.

Terra deployed, encircled, and closed down upon Mephisto III. A flurry of up-shooting energy broke out, catching the planet-slow spacecraft easily. Down fire crisscrossed the third moon of Mephisto, silencing some batteries.

The sluggers made a compact

mass, and dropped swiftly. Their AutoMacs scored and re-scored a ten-mile square until no answering fire returned. They spread, making a vast circle and spreading a curtain of MacMillan fire as they spread. The lighter ships and the fighter carriers circled up, around, and landed in the cleared area. Constellation craft paced above the sluggers, beating off attempts to break the tightly woven circle.

A barrier went up around the area, and the landed ships opened to disgorge spacesuited men. Planet-mount detectors were set upon prefabricated towers, and coupled AutoMacMillans pointed their mute parabolic bowls at the sky, awaiting the impulse from the detectors.

The barrier increased in size as the sweeping ships spread, and as the circle increased, more ships landed and set up more planet-mounts.

With a hundred-mile moonhead established, Terra's forces relaxed to rest, eat, and plan.

It was six solid weeks before Mephisto III belonged to Terra completely. But it was not six solid weeks of constant fighting. Wars are never constant fighting. Terra photographed the moon, and went in picked groups to blast reinforced spots as they were discovered.

At first it was fairly easy to find the embattled spots. Then as the Mephistans were cleaned out of area after area, the lesser spots became harder to find. Time and again a previously-blasted spot would return to life, and it became second nature for the Terrans to be wary of any smaller place that adjoined a dead and blackened place.

The total energy sent against the smaller places rose higher than the power directed at the larger places, since it appeared wise to give the charred spots another blasting for safety.

But Terra widened her circle, covered a hemisphere, and then began to tighten down on the other side.

The peak of effort was past, now, and with ever-lessening area to cover, the job of blasting Mephisto III clean and free of Mephistans dropped in magnitude.

Then like the closing of an iris, the circle of Terra's domain throttled the resistance, and Mephisto III was completely in the hands of the Terran forces.

Maynard called Sahara Base, reported, and called for reinforcements. With orders to sit tight and hold on, Guy returned to the moon to make the best of it. He hoped to have peace and quiet for a time, but peace was not for them.

As *Orionad* passed inside of the barrier that blocked all radiation from Mephisto III, a horde of Mephistan fighters circled down out of the sky, came through the barrier, and made a suicide attack against the ground forces.

Again they went through that saturation attack, and they silenced battery after battery. The roar of the attack came through the almost-nothing atmosphere, and the blasting of mighty bombs shook the ground and misaligned delicate in-

struments. The answering fire was terrific, and the fighters rose to fight the Mephistans off with subships and torpedoes.

Then this first raid was over. The Mephistans retreated and were gone in seconds, leaving the massed flight of the Terran Space Patrol with nothing to fight. They landed once again.

It was but a pattern for the days that followed. Regularly every thirty-one hours, twelve minutes, and eight seconds, a horde of Mephistans dropped down upon their third moon with all projectors blazing and then fled before the Terrans could take the initiative against them. It happened seven times this way, and then as the Terrans established the regularity of the attack, the Mephistans shifted the time, leaving the Terrans standing at their positions awaiting the order to go. Ten hours passed with no attack, and then Maynard ordered his men to relax. The wave of destruction came one hour later, and it was the same as before. The next time came within ten hours after the delayed fight, and the one after that waited until the Terrans were almost exploding with anticipation before it came. Three came within one day, and then nothing for a solid week.

Maynard swore and prowled his office in the *Orionad*. He lost sleep and worried ten pounds away. Then he ordered the *Orionad* outside of the barrier and contacted Sahara Base in person.

"Donigan?" he stormed. "When are the replacements coming?"

"Soon," said Space Marshal Donigan.

"That isn't good enough!" retorted Maynard. "This is no pink tea, Donigan. This is a matter of life and death. We have the moonlet you wanted for a base—we've had it for three weeks of sheer hell—and you say 'Soon.' With what I've got left I can't even make a stab back. It's no fun fighting a purely defensive fight, Donigan. You never know when the devils will hit, and my men are tired of being surprised in their beds."

"Do they do that all the time?" asked Donigan, thinking to chide Guy for exaggeration.

"About seven times out of ten. We may not know them, Donigan, but somehow they know us—all about us."

"What do you want?"

"Men, ordnance, materiel, hospital units, doctors, nurses, ships, and planet-fighters."

"Guy, you aren't going to blast the planet itself?"

"I sure am. At least I can make the fight come when I want it. This way, they'll blast us off of Three in another two weeks."

"You'll get them. They should be there now."

Maynard returned to the moonlet in hope—and he was watching the sky when the Mephistans hit.

Out of the black sky came a downpour of deadly torpedoes. They burst among the barracks, and though their detonations did no harm in the ultrathin atmosphere of Mephisto III, the fragmentation

shot the shelters full of holes and the trapped Terran air escaped. Men died in their sleep, that night, and the Mephistans covered the moonlet in sub-ships of their own devising.

"Sub-ships!" breathed Maynard.

MacMillan beams sought the invisible enemy, and their random hits were all too few. Maynard ordered them silenced, and the Terrans hurled material torpedoes into the sky. Up among the Mephistan sub-ships went the torpedoes, to burst with great, eye-searing gouts of radiant energy.

Thousands of the energy torpedoes went aloft, and they served their purpose. The barriers of the enemy ships collected the energy and heated the sub-ships to utterly unlivable temperatures—for the Mephistans. The ships dropped out of the sky—still enveloped in their barriers—and burst open against the hard surface of Mephisto.

Three days later, the reinforcements arrived. Terrans by the million swarmed the third moonlet of Mephisto, and the hemispherical shelters dotted the surface. Cylindrical runways connected one to the next so that spacesuits were not needed to pass from one to the other. Gigantic, permanent-mount AutoMacMillans were set up in readiness; and they assured protection against practically anything that flew the skies.

With the coming of aid, life took on a less hectic appearance, and smiles appeared once more. The medical corps took over, and the injured men received better care than with the rugged life on the tiny moon. Music filled the hemispheres, and though they could not go outside because of the atmosphere, things smoothed out as time went on. There were the reunions of old friends, and stories of those hectic weeks on Mephisto III were recounted and amplified in the time-honored Terran custom.

Even Guy Maynard.

He looked up from a sheet of figures into a familiar face and came to his feet in a jump. "Joan Forbes! What are you doing here?"

Joan waved the comet-borne caduceus before him and said: "Senior Aide Forbes, if you please. Fully graduated and ready for work."

"But . . . when?"

"I've been studying for three years."

"What about the ptomaine-palace?"

"I had to work somewhere to pay my tuition."

"What ambition!"

"Now stop sounding like a grandfather, Guy Maynard."

"But this is no place for a woman," objected Guy.

"Isn't it? Someone has to do the work."

"But this is grim work."

"So is life, Guy. Someone has to care for the injured. We've *got* to be here, you know. After all, we must be where the injured and dead are. We can only help them when we're on the very spot."

"But I think—"

"It sounds grisly? Maybe it is.

Look, Guy, I'm a healthy, normal woman, no different than the average. I'm not much different than the average male when it comes to stamina, fortitude, and will. Look, Guy, it's all right for other women?"

Guy's blank face told Joan that she had scored a hit.

"But you think it not all right for a friend of yours? That's stuffy, ridiculous, and hypocritical. Rot, Guy. After all, what's good for the patrol marshal should be good enough for the girl that pinned on his insignia."

"Hm-m-m, I suppose you're right."

"I *am* right. After all, in order to do any limb-grafting, the free limb must be fresh. A corpse will not keep too long, Guy. Autointoxication sets in and kills the cells, and then the limb is useless for grafting. The same is true for eyes, ears, and anything that can be grafted. All right," she snapped, "it's ghoulish to take a leg from a corpse and graft it on to a man who is alive but with a shattered thigh. It's inhuman? Not at all. Of what good to the dead is their lifeless body?"

"O. K., Joan, I didn't mean to sound sanctimonious."

"All right. It's pretty ghastly sometimes, but I think it's worth it all the way."

"I'm sorry, Joan."

"Well, consider me good enough to be where the trouble is," she said with a shy smile.

"Look, Senior Aide Forbes, you are as fine an officer and gentleman as I have ever seen, even though it did take an Act of Terran Congress to make a gentleman out of you. You have my undying admiration."

"You sound sincere," she said.

"I am sincere. Some day some bird will come along that's good enough for you."

Joan's peculiar glance was lost on Guy. "When he does," she said in a strained voice, "I'll follow him to the very end of the Solar System!"

She looked at him seriously, and then turned and left. "I'll bet she will at that," he said to himself, and then forgot her in the maze of figures on his broad desk. After all, he had an important decision to make, and a conference to attend within the next hour.

"Gentlemen, we'll by-pass One and Two, and hit Mephisto direct. I think we'll fox 'em that way, they'll be certain that we wouldn't leave a main base behind us, much less two bases. But we will, and by doing that we'll take the system!"

"And when?"

"As soon as we can mobilize. Hamilton, how soon is that?"

"Do you mean that?" asked Hamilton uncertainly. The conference laughed at his deep swallow. "All right. Three hours!"

"It's done, then! Come on, fellows. This is IT!"

The grand assembled fleet lifted from Three and headed for the planet direct. With numbers enough to invade a planet, they swarmed in and were met by planet-mounted beams that took a terrible toll with

their extra power. They hit Mephisto in one spot, and literally sterilized the planet for a hundred square miles. The weight of their numbers would have broken into any planet, no matter how armed. Invading was not difficult; keeping the break and spreading it to cover the planet was the difficult job. No defense can be set up against an enemy that is able to choose the time and place for his invasion. Once the invasion is made, concentration of power against the invader is possible, and that is the point in dispute.

So with ease, the Terran Space Patrol wiped out a hundred square miles of Mephisto and landed. Convoys poured in from Three, and the heavy permanent-mounts ranged the ragged square. Overhead, a horde of fighter-cover searched the skies for counterattack.

It was inevitable, and it came from all sides.

Across the plains of Mephisto came the tractor-mounted projectors. Maynard thought of the disperser screen, but behind that they were blind.

"Isn't there something better than this useless barrier?" he asked.

"Not that we know of," answered Williamson.

"Look, Ben, you take a hunk of that crew of yours and go out to the East, to sector G-21, and blast the power-conversion plant. Take the entire city if you have to. But get that plant!"

"I'll get it," said Williamson, and left. Maynard turned to Hamilton. "And you, Jack, get some of your heavies into action against sector A-13. You know the target we want destroyed."

"I sure do. And I'll get it!"

He turned to the commanding officer of the forces that arrived with the reinforcements. "Can you hold them to the north, south, and west? If so, can you advance to the east?"

"That's quite a job."

"Can you?" demanded Maynard.

The other man looked at Maynard's nebula and then down at his own rayed star. "I'll try," he said.

"No, Walter, say 'I'll do it!' and then try. We're counting on you."

There was a three-mile border around the hundred square miles of Terran-held Mephisto. It was a terrible border now. It was a solid mass of flame and fragment, and it was creeping inward slowly. Saturation destruction, it was called, and if successful, obliterated not only the enemy, but also his traces.

Above, the circling of tiny fighter ships darkened the sky, and the rain of broken ships became dangerous.

And then a wave of intense hatred filled Maynard. It was so violent that he found himself climbing the roof of his shelter to man one of the AutoMacMillans himself. He got control of himself, and saw that all the Terrans in the field of his sight were positively writhing in hatred. Shaking his head in wonder, Maynard returned to his scanning room and watched the luminous map of operations.

He was amazed to see that the sides of the square held by the Ter-

rans were advancing, closing down that barrier of fire that bordered the square. The east side, which should have advanced slowly, was rocketing forward at a dizzy pace.

The wave of hatred diminished, and so did the swift advance. The battle settled down to a continuous roar.

Hamilton's group returned and as the sector commander landed to report, his command roared through the skies above the embattled defenders of the planet and poured destruction down upon them. Hamilton came in and told Guy: "We did it, but what a cost!"

"Bad?"

"Terrible. They hacked at us all the way there and all the way back—and when we got there, that place was defended like Sahara Base itself."

"But you got the target?"

"We did."

"Good. Can you get the target in sector L-14 now?"

"If my command holds out."

"Go ahead then—and we'll meet you at Area 2. Don't return here at all."

"I get it. You're going to abandon this place?"

"No. I'm going to hit F-67 with three quarters of the main fleet. That'll divide their defenses and we'll end up with two hundred-mile areas."

"You're going to leave enough here to hold this place?"

"Yes. It'll be tough going, but once they're divided, it'll be easier here. With three quarters of our fleet attacking another place, they'll be forced to follow. Look, Hamilton, some of their power is down! Ben must have got that power conversion plant!"

"When are you leaving?"

"As soon as Ben returns. Hello," he said, turning to see four officers struggling with—*a creature.*

"We caught this one alive," offered the foremost. "Thought you'd like to see what we've been fighting!"

"Nice to know," said Maynard drily. "What now? Do you expect me to give it tea?"

The laugh was universal. But the creature straightened, and waved the tentacle on top of the shapeless collection of antennæ, tendrillike fronds of hair, and wide, flat appendages that must have passed for the head on Mephisto. It whipped the tentacle to the back of the head and found a curved case that fitted the back of the head. Another tentacle tore from the officer's grasp and found a similar box at the belt.

It turned a knob on top, and Maynard whipped his MacMillan from its holster and blasted the tentacle off at the "shoulder."

And then, in Maynard's mind there came a thought. It staggered the patrol marshal, and he blinked in unbelief. It rang in his mind: "You shouldn't have done that!"

"What?" asked Maynard aloud. "Why—?"

"You shouldn't have done that. I meant no harm with this. Now I may not retune it to your fellows."

"But—?"

"It is a development that will ul-

timately win for us," came the thought. "A thought-beam transmitter."

Maynard sat down suddenly. "No," he said. "I'm mad! I must be."

Hamilton said: "That I doubt, Guy. What's the matter, though. You look ill, but madness I doubt."

"He says that thing on his head and belt is a thought-beam transmitter."

"What? He says—?"

"That's his thought. But it can not be—"

"Or can it?"

"Your misbelief is amusing in the face of fact," came the amused thought. "Tell me aloud to perform some simple action."

"Can you sit down?" asked Maynard.

To the amazement of everyone, the creature bent in the middle and seated itself on a stool.

Hamilton smiled foolishly. "From here on in, Guy, that's a thought-beam transmitter. Take it from there and go on."

Guy smiled and nodded. "I'll accept it."

"It's the explanation for a lot of things," said Hamilton. "Their concentration of forces against selected targets, for instance. Their use of the barrier."

"Naturally," came the Mephistan's thought.

"I thought you couldn't tune to them," remarked Guy.

"They spoke to you—your mind followed their speech; I followed your mind. I can not talk to them direct."

"I see. It's logical. But why did you permit us to get this far?"

"You are alien; tuning the instrument to your very alien minds was a matter of hundreds of years. We have been trying, and only succeeded after the first horde of you came close—landed upon Ungre—and gave us a large thought-input to work on."

"But why did your kind fight us from the very beginning?"

"Because we know what manner of mind you have. We saw it in action before."

"Surely you knew that we would negotiate with you?"

"To our disadvantage."

"Not necessarily."

"Don't be ridiculous," came the thought. "You and I both know that the Solar System is not large enough for both our kinds."

"We have no desire to own your world."

"No? Then what are you fighting for?"

"For the right to negotiate with you—and to uphold our honor. After all, we were fired upon without provocation."

"You are the commander of the Terran forces here. Suppose a race came to Terra. Suppose this race was one you knew to be absolutely ruthless, grasping, ambitious, and proud. Suppose you knew this hypothetical race to be the one that used a minor race as subjects in vivisection; and because of valuable minerals on another planet, this race oppressed still another race and held them in ignorance so that the true value of the minerals was not known

to the ignorant natives."

"You're speaking of the trogolodytes of Titan—who haven't the power of reason. Why shouldn't we use their bodies as experimental subjects to aid our researches into the subject of medicine?"

"Because they, themselves, are life!" came the scathing thought. "Given the opportunity, they develop reasoning minds and are quite intelligent. Their environment holds them back. Titan is a poor place, destitute of minerals and unproductive of easy living, such as is necessary for civic advancement."

"That I do not follow."

"In order that a race advance, he must have time to think. That means leisure. His living must come easy enough to give this race time to think, and to dream, and to plan. When scratching a living out of nature becomes a full-time job, little civic advancement can prevail. Also, on Titan, he is already supreme as far as his native enemies go. There is nothing to drive the Titan to his fellows for mutual protection. Each Titan is alone because he has nothing to fear, not even his own kind.

"But," continued the Mephistan, "give him the opportunity, and you will find that the Titan can evolve into intelligent life. Say three generations!"

Guy let this matter drop, and said: "And your other statement pertains to Pluto."

"Certainly. Valuable ores were found on Pluto. Also a race of semi-intelligent natives. They traded worthless bits of glass and glittering, chromium-plated jewelry for gray and shapeless masses of dirt—but the dirt must be excavated from certain locations, and in certain ways. To keep the ores moving, and at this ridiculous rate of exchange, no program of education was installed on your Pluto. Even your Men of God—missionaries—obscured the real value of those ores. What did you give them in exchange?"

"We gave them protection against a common enemy."

"An enemy of yours that would probably have treated them no worse than you did. The protection you prattle of was protection of your own mines against the enemy, not of the natives against this enemy. In either case, the natives would be no better off."

"You paint our race as black-hearted," said Guy.

"And what did you do?" came the cynical thought. "As soon as you discovered this barrier-screen, you raised it over Pluto, and the rise in temperature, good for Terrans, killed the Plutonians to the last one! A benign race? Bah!"

"We—"

"Nothing you say will convince me that your main desire is not for yourselves! And if you think for one moment that we will permit you to throw up a barrier around Mephisto and kill us off, you're mistaken."

"You're all convinced that we mean harm?"

"You do!" The creature tapped the thought-beam instrument.

"I presume that you speak for the entire race?"

"I do. You, with your so-called democratic government; with your populace swayed by orators; with your justice biased with bribery; with your elections purchased by the highest bidder, could not possibly understand how a race could hold an honest government. But we do," said the Mephistan proudly. Again he tapped the thought-beam instrument. "This instrument tells the truth! No silvery-tongued orator can sway the people; no biased judge can color the evidence; no public servant can buy an election, for problems of state are presented via thought-wave, and a liar is detected! When you first advanced into the planets, we saw your progress. And when we found you in our system, we knew your real thoughts at last! We broadcast your hidden purpose and to the last Mephistan, we decided to fight! To the last one of us we will fight, for we know that your purpose is to move in on us and run us to death. We have nothing to lose but our lives, and those we will lose if we permit your invasion."

"You hold us in deep contempt," said Maynard. "Therefore your statements themselves are biased."

"They are not. Perhaps, with this instrument, we know you better than you do yourselves. You are death for us—unless we become death for you!"

"But what can we do when you fire upon us without provocation?"

"Stop prattling about provocation," came the thought. "When a

burglar pries his way into your living room, do you wait until he collects your valuables before you fire on him?"

"Now we're burglars?"

"Worse. A burglar knows that he is doing wrong."

Guy shook his head. How could he make this creature see that Terra meant no real harm until the Mephistans made the first aggressive move?

"You made the first aggressive move," said the Mephistan. "You made it when you first landed on Titan. You made the second on Pluto. What is your feeling toward Mars? You plan extermination for them—and they only desire to grow with you."

"They—"

"Only fought back when you fought them. Only this"—tapping the instrument at his belt—"will keep us from falling in death. You, yourself, brought home many new concepts from Ertene which will throw the balance of power for Terra."

Guy started, and then looked wildly around at the other officers in the room.

"I know of Ertene from your own mind," said the creature. "These others can not hear my mind. But I curse Ertene for the things she gave you; they will make our battle difficult."

"It will make your fight impossible," said Maynard, catching the brief flash of a hidden, fearsome thought in the Mephistan's mind. He turned to Hamilton and said: "Set up a barrier about the system, and focus the output of the screen on the center of Mephisto!"

The creature snarled audibly; it was the first sound ever heard that was made by a Mephistan. He drove forward, shaking the officers' grip from him as though the hold was nothing.

A darting tentacle lunged forward like a rapier; and like a rapier it impaled Hamilton through the throat. Withdrawn, it flattened and swung like a scimitar in and among the stunned officers.

They came to life and rushed the Mephistan. Crowding the creature close. The stool upon which he had been sitting was lifted high in another tentacle and it shattered to bits against the skull of the tallest officer in the room. The other three grappled with the Mephistan and bore him backward to the floor which may have seemed desirable to the Terrans. It was also desirable to the Mephistan, too, for it gave him a more solid basis for his slashing attack. He cut through one officer's midsection entirely, crushed the skull of the next against his own by driving that bullet head forward, and then picked the last from the floor in his tentacles and dashed him across the room against the wall. The body crunched, quivered, and fell to the floor.

Maynard lifted the MacMillan and drilled the Mephistan again and again. His eyes blazed with hatred for the alien creature, and his mouth curled in utter distaste. The room

filled with the stench of—burning varnish!

"Naturally," came the thought, continuing as though nothing had happened, "I could not come to such a fearsome temperature as you maintain and hope to live. You seem to have destroyed my servant, but we shall destroy you!"

When the aides came to clean up Guy's office, they found him inspecting the little instrument that fitted head and waistline of the alien creature. It was off, now, and partly disassembled upon the patrol marshal's desk.

Williamson came at Maynard's call and raised an eyebrow at Maynard's action.

"I had to do something," said Guy in a flat voice. "I couldn't just sit here and contemplate those bodies."

"I know," said Ben softly. "Anything I can do?"

"Yes. Set up a barrier. Focus the screen's output on the center of Mephisto. And then maintain that barrier for your life—and it will be just that. It will be for your very life, for it will be against the lives of all Mephistans!"

"Good!" glowed Williamson. "That'll do it!"

"It may take months," said Maynard. "But from now on we're fighting a winning battle."

"What is that thing you're tinkering with?"

"A goldberg that was on the creature's body. Interesting thing, too. Look, Ben, this thing may have been a robot, but their psychology is such that they hate us completely. Issue orders that no more prisoners are to be taken. Extermination is the only way; their strength is such that three of them could wipe out a regiment. If we don't exterminate them, they'll exterminate us, and they can do it if we permit them one chance. We'll not give them that chance. Have the technicians figure out the estimated temperature rise of Mephisto with a full screen and full output directed at the center of the planet. I'd like to know when this affair can be considered over."

"Check. I'll do it, Guy. What you need is a rest."

"I know. But there'll be no rest for any of us until this fight is finished. Come on, Ben. Let's get moving. We've got a job to do."

XII.

Guy put the alien instrument in his personal locker and went to see how the battle was coming. Out across the face of Mephisto, he saw the battle machinery locked in mobile death with the huge, alien machines of Mephisto.

The ground was strewn with smoking ruin, and Guy saw with horrified gratification that the ruined machinery was all on the Terran side of the battleground—which meant that his ring of offense was advancing. The energy bombs were bursting above the planethead, and the sky was filled with blinding light. Sub-ships fell as their drive was burned by the entrapped energy within the barriers, and Guy

wondered how many men were getting energy burns from the terrific radiation from the energy bombs.

Orionad, standing in the circle of planeted ships, was dealing power blows from the turrets, and beams of energy—just energy—were roving the sky to saturate the barrier-protected sub-ships. Now and then a MacMillan beam would touch one of the sub-ships unawares, and there would be a terrific blast as the entire ship exploded instantly.

Then Guy saw his forces waver slightly, fall back, and then go down in a terrible wave of destruction from massed sub-ships.

Again they retreated, and as the next wave dropped, they expended their energy on nothing but the bald surface of Mephisto. The solid ice of Mephisto boiled into great clouds of vapor and liquid water ran across Mephisto's face for the first time.

The vapor clouded operations—for both.

One sub-ship scraped Mephisto—broke the barrier, and slid through a crashing pile of accumulating rubble to a destructive stop.

And on one upthrust plate, torn and almost obliterated, was the device of the Martian Space Guard!

"Martian!" breathed Guy.

"Right!" agreed Ben.

"Check that wreck!" exploded Guy. "What's running it!"

His order was passed; fifty Terran machines raced forward and encircled the smoking ruin; and seven of the planeted constellation ships blasted a pathway back to safety for the carry-alls.

The ruined Martian ship was dropped in a clear area, opened by brute force, and through the torn plates streamed a group of cautious Terrans. They emerged immediately.

"Martians!"

"The devil! They've made a pact!"

Maynard looked understandingly at the broken ship. "Naturally," he said sourly. "What would you do?"

Williamson looked up and nodded. "Right. Well, does this change anything?"

"No—unless it is to apply what we know about fighting Martians to the present situation. We didn't consider this possibility."

As Maynard turned to re-enter the *Orionad,* eighteen of Hamilton's raiding horde returned in a screaming landing. Hamilton came out, white-faced, and said, dully: "It was sheer hell—both ways. We got 'em—but they hit us with the book. Sixty percent lost!"

"How do you feel?" asked Maynard.

"I don't know."

"Take your command out again and hit Sector F-67."

Hamilton looked up in surprise, and then anger crossed his face. He saluted and said: "Yes sir!"

As he turned to go, Maynard called softly: "Hamilton! We're fighting Martians now—they've made a pact!"

Hamilton turned, looked at Maynard, and muttered something that Guy could not hear over the roar of

battle. Then he returned, and faced Guy.

"The stinking, rotten devils—!" His face cleared, and he left.

Behind the embattled lines of the Mephistans, Martian craft landed. Martian sluggers, Martian power-craft, Martian constellation class super battlecraft. And as they were landing, and getting set for an open battle, the Terran forces lined up behind the thin line that flanked *Orionad*.

It was a situation that made Maynard start. For years, no real action had ever been fought between the two forces. Sorties, scrapes, incidents; these had been the sum total of the trouble between the denizens of two worlds. Ream upon ream had been written concerning theoretical battle-plans for war against Mars, and in the Martian pictographs, equally large quantities of ink and paper went into the libraries on how to fight Terra.

Guy realized: *Here it is!*

The power ships of the two forces faced one another across ten miles of plain. Above the heads of each roved the tiny fighters, and above this cover, reaching up far into the realm of space, were rising the battlecraft.

Planet forces began to move against one another, right through the unseen death that roved from the MacMillans on the tractors and the moving pillboxes. Space above the battleground filled with a continuously exploding roar, and sheets of released energy flares at the meeting points of crossed MacMillans.

The constellation ships fenced momentarily, and then roared forward into full battle. The sluggers stood back and threw the might of their energy from long range. Tiny fighters raced forward, depending upon speed, mobility, and minuteness to escape the wary detector-coupled AutoMacs.

Sight became impossible. The flaring of explosive and raw energy seared the eye that dared to look, and when the flaring light stopped by chance, the rising wreaths of smoke, steam, and incandescent vapor obscured the vision. Lightnings flashed in and through this cloud, and the instruments became wabbly.

Fire ceased briefly, and both sides waited for the veil to clear. Technicians put the cancel plugs on ruined targets to clear them from further destruction, and turretmen served the heating projectors.

A wave of sub-ships zoomed in and spread flaming death among the Terran forces, and the energy bombs poured up, and among the barrier-protected ships. A group of Martians holding disperser screens zoomed over, spreading energy in wide-aperture releases from their turrets. Bombs and torpedoes raced in through the disperser screens, and the blind crews died without knowing whether they had hit anything. Terran sub-ships crossed beneath the first wave of Martians, and hit the enemy. A veritable fence of exploding ships barred the view as sub-ships collided. Their in-

detectability was mutual, too.

Like twin tornadoes, the ships of both worlds spun upwards in a vast, whirling spiral. Bits of dust, smoke, and vapor intermingled with the ships, giving them a definitely tornadolike appearance as they swept the surface of Mephisto towards each other.

The volume between the twin vortices was torn and blasted. Slowly and ponderously they moved together, and as they intermingled in a whirling eddy of battle, the ground of Mephisto was scoured clean of life.

The weight of Terra's forces carried the most momentum, and the spout moved across the territory formerly held by Mars.

Reinforcements swooped in from space, and the whirling mass expanded. And with gathering speed, the vortex moved in an irregular path across Mephisto, sterilizing the planet as it went. Mephistans went before the tornado of huge battlecraft as straws go before a hurricane.

The path of the storm was strewn with smoking, ruined ships. The luckless were forced inside of the whirling cylinder and gunned there. They fell down that chimney of death to the ground that awaited them at the bottom, or crashed against uprising sub-ships that swooped upward through the vortex and fired on all sides, relying on the identifier-couplers that stopped their aim against their fellows.

The vortex broke, and the Terran ships opened from circle to crescent to straight line to closing crescent and strove to encircle the Martians. Outnumbered now, the latter fled slowly and kept up a killing fire of retreat.

Across the face of Mephisto arrowed the embattled fleets. A wall ten miles high and fifty miles long and thirty miles from front to back accelerated and swept everything before it. Between the two walls of fighting ships was a constant flare of death. Cities caught in the conflagration died; their buildings seared, blasted, and broken.

In full rout, the Martian forces raced to converge upon a large city.

In a tight circle, the Martians braced themselves. Power beams came from the city to feed them, and as Terra came before them they lashed out with the power of planet-supported fire. Terra englobed the city, but it was a questionable success.

From horizon to zenith, the Terrans poured their power into the Martian hemisphere. The ground about the city ran hot, and the grounded ring tilted and mired down, but they continued to fire back. Stalemate set in; Terra could not breach that close-knit hemisphere and Mars could not fight off the pressing Terrans. Destroyed torpedoes filled the annular gap with explosions, and crossed MacMillans flared to sear the eye.

Then a mile inside of the Martian ring, the ground heaved upward, and the ugly snouts of underground raiders appeared. Their

protected turrets lifted out of the blisters and began to pour energy into the Martians from behind. The Martians swept downward from their hemisphere and fought back against the pincer-movement. The topmost Terrans pressed downward as a second ring of underground raiders appeared to bolster the first wave.

The city erupted in tiny areas as Terran undergrounds broke the surface, blasted the interfering building away with torpedoes, and lifted to add to the ever-increasing energy of the battle.

The Martians hopped backwards over the ring of undergrounds and set up an inner line. At point-blank range, and almost plate to plate, the Terrans massed their energy in a flaming wall of destruction, fighting the Martians back, foot by foot.

The circle tightened upon a tiny, central park. Spacesuited figures worked furiously under a disperser screen; they were putting the last touches upon an alien projector. No light came to them from without, but they could be seen by the light of their own working floods. Outside of the projector and the disperser, a ring of large detector-coupled MacMillans were dancing from point to point and dropping Terran ships with each point.

"Ben!" snapped Maynard. "We'd best get that thing before they finish!"

"Right. We'll hit 'em with Auto-Macs and keep 'em under constant fire."

"No good."

"We can't hit 'em through that disperser, but they can't see to hit us."

"I know. But there's one thing they don't need sight to hit."

"Huh?"

"Mephisto III, you idiot. Could you hit Luna from Terra without aim?"

"If I had an ephemeris."

"What do you suppose they call theirs?"

"I—"

"Break out a ground force," ordered Maynard. "We're going to take that projector!"

The Terran fire tripled as the ground force moved ponderously across the intervening yards. A salient point was made, and the sides began to widen. Back and forth the individual sorties went, and as men and machines went up in flaring puffs of fire, the salient moved forward toward the projector.

Inside the disperser, the combined Martians and Mephistans worked furiously, though they seemed oblivious to their danger. No signals would enter this barrier, and no living thing could step outside and hope to re-enter.

They stepped back from the thirty-foot parabola, and one of them thrust down upon a plunger.

Above the parabolic reflector, a thick haze formed. A torpedo succeeded in passing the coupled Auto-Macs and raced inside of the disperser and into the haze. It ex-

These people buy a battleship —every week!

Meet John S. . . . . and Mary D. . . . . .

Between them, they put almost 30% of their pay into War Bonds—and have for 2 years.

John and Mary are typical of more than 27 million Americans on the Payroll Savings Plan who, every single month, put half a BILLION dollars into War Bonds. That's quite a chunk of money—enough to buy one of those hundred-million-dollar battleships every week, with enough money for an aircraft carrier and three or four cruisers left over.

In addition, John and Mary and the other people on the Payroll Plan have been among the biggest buyers of *extra* Bonds in every War Loan Drive.

When this war is finally won, and we start giving credit where credit is due, don't forget John and Mary. After the fighting men, they deserve a place right at the top of the list. They've earned it.

You've backed the attack—now speed the Victory!

STREET & SMITH PUBLICATIONS, INC.

This is an official U. S. Treasury advertisement—prepared under auspices of Treasury Department and War Advertising Council

ploded, and its energy added to the forming vortex.

The haze thickened, became toroidal, and spread out. Up from a dun color it went, into cherry-red incandescence. Up through the red past yellow into blue and then into flaming white went the color-temperature. Like a close-knit toroid of flaming, white-hot metal, it poised above the projector, moved slightly, and then raced upwards. It passed the disperser, and the screen went up in a flare of white.

Into the sky above Mephisto went the toroid, and below it, Terrans swarmed over the projector, fought off the remaining enemy, and held the projector as their objective. The last floods of resistance died as the toroid went into the far sky above.

"Orionad!" bellowed Maynard. His ship lifted, swooped over him, and lifted him on a tractor. Upward they raced, catching the slow-moving vortex.

Turret-mounted AutoMacs vomited energy into the vortex—and back-thrusting power burned out the feedlines. Torpedoes entered the flaming mass and just disappeared. Tractor beams slid from the coruscating surface and pressor beams found nothing against which to push. A sub-ship plunged against the vortex. It was stripped of its barrier and it floated down, inert, and started the long fall to the hard ground below.

Fighting against the vortex with weapons that did no good, and cursing the foul thing all the way, Maynard and the *Orionad* followed its ponderous course out and out and out to Mephisto III.

It spread as it went, and by the time it wrapped its tenuousness about the tiny moon, it was almost gone. But it contained strength enough to blow out the barrier generator that held Mephisto III invisible from without.

The toroid disappeared, and Guy, with misgivings, made inward to land at the base.

His fears grew as time went on, for he was not challenged. A swift report gave him some hope, but it came from Mephisto itself, telling him that resistance was at an end in the sector he had just left, and that the fleet, victorious and supreme on Mephisto, was returning to the outer moon.

Guy worried. Returning to what?

Inspection showed that nothing was harmed—save life. Dead men sat in their places operating instruments, dead men patrolled unseen areas, dead men manned the landing ports. It was a moon of the dead—with every instrument operable.

Not a machine was damaged—but no living things remained on Mephisto III.

Broken with grief, Guy Maynard looked down on the silent face of Senior Aide Joan Forbes. He felt wooden, and it all seemed dreamlike and unreal, but he knew that this was no dream, but cruel reality. Hat in hand, he stood there as if frozen and searched the girl's face

Turkey...

and Holly...

and Christmas Seals

THEY only come once a year—*turkey and holly, carols and cranberry sauce!*

And only once a year do you get a letter enclosing the seals that save life — *Christmas Seals.*

Answer the letter! Christmas Seals make possible the year-round fight against Tuberculosis and are *your gift to all humanity.*

What better way to remember His birthday?

BUY CHRISTMAS SEALS!

The National, State and Local Tuberculosis Associations in the United States

as though expecting the closed lips to part in a smile, and the closed eyelids to open before a pair of twinkling eyes. His men knew of the affection there, and they pitied him silently.

In neat, geometrically precise rows; seven billion, four hundred million miles from home; on a tiny, almost airless moonlet of an alien planet the hundreds upon hundreds of physically perfect bodies were buried. Not a scar or burn marred them, yet—

The chaplain said: "—from the earth thou camest, and to the earth thou hast returned. And though this earth is far removed from the earth which bore thee and thine, it is thy resting place and home, for in the eyes of God Almighty all places and all planets are His Domain. And though ye travel to the farthest star, yet you will find Him there before thee, and this we know and believe for His Only Begotten Son hath said: 'My Father hath other worlds beside thine.'

"And so we consign these erstwhile friends of ours to the depths of the earth, knowing that time and space knows no deterrent to Our Father Almighty; We shall all meet again some day—"

Guy Maynard plodded away from the scene. His eyes were dry, and in his heart was nothing. Shock had taken control of Maynard. Through the rows of mounds he walked, back to the *Orionad,* and his entry into the super-ship failed to give him that lift he always felt.

He sat in his scanning room and stared at the blank wall. Nothing aroused him. Nothing caused him to think; his mind was almost a blank, and it raced with futile rapidity from scene to scene with no plan, no reason.

An hour he sat, and the shock began to wear off. It left him with heartbreaking grief, and Maynard put his hands over his face and wept bitter, honest tears.

A phrase crept into his mind: "—the fortunes of war—!"

Maynard hated it. He hated the unknown who first said it. And then his hatred changed to the creatures that had created this ill fortune. He arose, his eyes blazing; and he thought:

Am I mad?

How could any man with such hatred be anything but mad?

Then I am mad!

He stormed out of the scanning room and went to the upper turret. He strode in, and saw that the super-projector was being installed there. Williamson turned and his face softened.

"Well, Guy?" he asked quietly.

"It's not well!" snapped Guy. Then his voice cleared and he said: "Sorry, Ben. When?" he asked, meaning the vortex-projector.

"Now, I think. We lifted it wholesale, generators and all."

"Then blast the accursed planet until it writhes!"

The vortex formed and hurtled down upon Mephisto. Again it formed and went down, following the first. Rings of violent energy, the vortices flew from the snout of

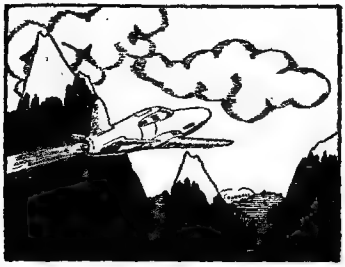
the projector one after the other, time and time again until Ben stopped because the power was running low. Lines were thrown in from adjoining ships and the everlasting barrage continued. Hour after hour it went on, and each vortex laid waste to a section of Mephisto.

And long after the last Mephistan was dead, the Terran torpedoes dropped on the planet. His men wondered, but still there came no order to cease fire. Moonlet-mounted AutoMacs crossed the void and scored Mephisto, and when the final blast was fired and the Patrol landed upon Mephisto, no complete article of Mephistan life was anything but a smoking, charred mass.

The taking of Mephisto was finished.

And Guy's hatred had passed through the saturation point, and all that was left to him was a dull ache. Shock had taken him again; it was with a dull, toneless voice that Guy issued orders to return the *Orionad* to *Sahara Base*.

TO BE CONCLUDED.



Win WAR BONDS
A GRAND TOTAL OF
$1,000.00
IN PRIZES
FOR YOUR IDEAS

Midwest Radio Corporation — since 1920, famous for fine radios, and their factory-to-you selling plan with savings up to 50%—looks to the post-war future. To build the kind of radio you want, they ask you now to submit a letter on the subject: "What I Want In My Post-War Radio." For the 11 best letters, Midwest will give $1,000.00 in War Bonds. Letters must not exceed 200 words and you may send as many entries as you wish. Letters will be judged on the practical value of the ideas contained therein and the decision of the judges will be final. In case of ties, duplicate prizes will be awarded. All entries must be postmarked not later than midnight December 31, 1944. Contest is open to all except employees of Midwest Radio Corporation, their advertising agency, and members of their families. Winners will be notified on January 31, 1945. Prizes will be awarded as follows:

First Prize. . .$500 in War Bonds
Second Prize $200 in War Bonds
Third Prize. .$100 in War Bonds

and eight prizes of a $25 War Bond each.

Send your entry to Contest Editor at the address shown below.

MIDWEST RADIO

MIDWEST RADIO CORP.
Dept. 42-C Cincinnati 2, O.

NEW SICKNESS AND ACCIDENT PLAN PAYS $25 WEEKLY BENEFITS

Costs Only $12 a Year—Down Payment $2.50 —Hospital Benefit Included

NEWARK, N. J.—The 58-year old North American Accident Insurance Company of Chicago, announces a new plan that pays $25 a week for 10 weeks for both stated accidents and sicknesses. Plus an additional $25 a week for 4 weeks for accidents requiring hospital confinement. Yet the total cost is only $12 a year. The purpose of this new Premier Limited Double Duty Policy is to bring sickness and accident protection within the reach of men and women who do not have large savings with which to meet sudden doctor or hospital bills, or lost income.

This new plan also has a double-indemnity feature covering travel accidents. You receive $50 a week if disabled by an accident in a bus, taxicab, street car, train, etc., and $75 a week if the accident requires hospital confinement. There is another new special feature that pays up to $25 cash for doctor bills, even for a minor accident such as a cut finger. In case of death by a common accident, the policy pays one thousand dollars cash to your family. Two thousand dollars if caused by a travel accident.

In addition, it covers many common sicknesses, such as pneumonia, cancer, appendicitis, etc., paying the weekly benefits whether confined to home or hospital.

The entire cost is only $12 a year, and that applies to men and women between the ages of 15 and 64 inclusive. Between the ages of 65 and 75 the cost is only $18 a year. You are protected 24 hours a day. No reduction in benefits regardless of age. No medical examination is required.

Men and women who join the armed forces will receive the full benefits of this protection while in the United States.

North American Accident Insurance Company of Chicago is one of America's great insurance companies, the largest and oldest exclusive health and accident insurance company in this country. It has paid out over $35,000,000 to grateful policyholders when they needed help most. North American is under the supervision of the Insurance Departments of 47 States and District of Columbia.

Men and women who would like full details about this new plan are urged to write a letter or postcard for a revealing booklet called "Cash or Sympathy". This booklet is absolutely free. It will come by ordinary mail, without charge or obligation of any kind. No one will call to deliver it. We suggest you get a free copy by sending your name and address with postal zone number to Premier Policy Division, North American Accident Insurance Co., 830 Broad Street, Dept. 1945, Newark 2, New Jersey.

JUST OUT! NEW FROM COVER TO COVER!

AUDELS REFRIGERATION and AIR CONDITIONING GUIDE

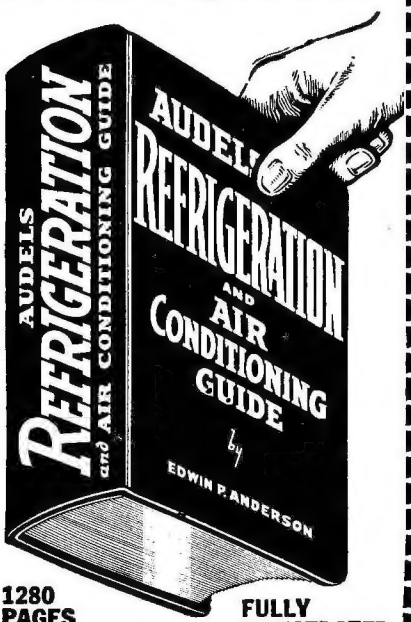
"AUDELS REFRIGERATION & AIR CONDITIONING GUIDE." 4 Books in One: covering the basic principles, servicing, operation and repair.

1. HOUSEHOLD REFRIGERATION
2. SPECIAL REFRIGERATION UNITS
3. COMMERCIAL & INDUSTRIAL REFRIGERATION
4. AIR CONDITIONING SYSTEMS

A gold mine of essential important facts for ENGINEERS, SERVICEMEN, SHOPMEN AND USERS.

A good book is a good friend! Here you will have at your fingers' ends a complete library in ONE VOLUME, the necessary data you have been looking for on: MODERN UNITS, SYSTEMS AND MACHINES, REFRIGERANTS, including Freon, Quick Freezing, Lockers, Water Coolers and Air Conditioning Systems. 1280 pages, 46 chapters all fully illustrated and indexed for ready reference and answers to your questions. Size 4¾ x 6½ x 1¾. Flexible covers.

Ask to See It!



1280 PAGES **FULLY ILLUSTRATED**

TO GET THIS ASSISTANCE FOR YOURSELF MARK FIRST BOOK (X) ON MAIL ORDER COUPON NOW. $4 COMPLETE PAY ONLY $1 A MO.

THEO. AUDEL & CO., 49 W. 23 ST., NEW YORK 10, N. Y.

CUT HERE

MAIL ORDER

THEO. AUDEL & CO., 49 W. 23 St., New York 10, N.Y.

Please mail me for 7 days' free examination the books marked (X) below. I agree to mail $1 in 7 days on each book or set ordered, and to further mail $1 a month on each book or set ordered until I have paid purchase price.

If I am not satisfied with Guides I will return them.

- ☐ Audels REFRIGERATION & Air Conditioning Guide $4.
- ☐ Audels PUMPS, HYDRAULICS & AIR COMPRESSORS 4.
- ☐ Audels WELDERS GUIDE 1.
- ☐ Audels BLUE PRINT READING 2.
- ☐ Audels SHEET METAL WORKERS Handy Book 1.
- ☐ Audels SHEET METAL PATTERN LAYOUTS 4.
- ☐ Audels AIRCRAFT WORKER 1.
- ☐ Audels MATHEMATICS and CALCULATIONS 2.
- ☐ Audels MACHINISTS & TOOLMAKERS Handy Book 4.
- ☐ Audels DIESEL ENGINE MANUAL 2.
- ☐ Audels MECHANICAL Dictionary 4.
- ☐ Audels AUTOMOBILE GUIDE 4.
- ☐ Audels MARINE ENGINEERS Handy Book 4.
- ☐ Audels SHIPFITTERS Handy Book 1.
- ☐ Gueths MECHANICAL DRAWING COURSE 1.
- ☐ Rogers DRAWING and DESIGN 2.
- ☐ Audels MILLWRIGHTS and Mechanics Guide 4.
- ☐ Audels CARPENTERS and Builders Guides (4 vols.) 6.
- ☐ Audels PLUMBERS and Steamfitters Guides (4 vols.) 6.
- ☐ Audels MASONS and Builders Guides (4 vols.) 6.
- ☐ Master PAINTER and DECORATOR 2.
- ☐ Audels GARDENERS & GROWERS GUIDES (4 vols.) 6.
- ☐ Audels ENGINEERS and Mechanics Guides Nos. 1, 2, 3, 4, 5, 6, 7 and 8 complete 12.
- ☐ Audels Answers on Practical ENGINEERING 1.
- ☐ Hawkins Aids to ENGINEERS EXAMINATION 2.
- ☐ Audels WIRING DIAGRAMS 1.
- ☐ Audels Handy Book of PRACTICAL ELECTRICITY 4.
- ☐ Audels ELECTRICAL POWER CALCULATIONS 2.
- ☐ Hawkins ELECTRICAL Guides at $1. each 10.
- ☐ Audels ELECTRONIC DEVICES 2.
- ☐ Audels ELECTRIC Dictionary 2.
- ☐ Audels RADIOMANS GUIDE 4.
- ☐ Audels NEW ELECTRIC LIBRARY at $1.50 a Volume Vols. I, II, III, IV, V, VI, VII, VIII, IX, X, XI, XII.

*Name*_____

*Address*_____

*Occupation*_____

*Employed by*_____ JACK

Anyone who knows can tell the REAL THING!

If you're a judge of fine whiskey, you know Calvert is *the real thing*. One taste tells you this superb blend is at its peak of pre-war excellence ... a whiskey that can't be imitated! A greater supply is now available ... so if you keep asking for Calvert, chances are you'll *get* it. Enjoy America's Finest Blended Whiskies—from the House of Blends! Calvert Distillers Corp., N.Y.C.

Today, more than ever...

CLEAR HEADS CHOOSE CALVERT

86.8 Proof. Calvert "Reserve:" 65% Grain Neutral Spirits...Calvert "Special:" 72½% Grain Neutral Spirits

ASTOUNDING SCIENCE-FICTION

JANUARY 1945